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ESPON Climate
Climate Change and Territorial Effects on Regions and Local Economies

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Final Report

Annex 1

Case Study Alpine Space

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This report presents the final results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

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1 Summary

Within the last 200 years both summer and winter tourism emerged as core economic sectors within the Alpine countries. After the Mediterranean Region the Alps are the second most favoured holiday destination in Europe. With 60 million overnight guests tourism is the most important economic sector in most rural and alpine regions in the European Alps. At the same time tourism in the Alpine region is one of the economic sectors most affected by climate change.

The case study aims at an in-depth analysis of impacts of the different climatic stimuli on Alpine tourism, of the specific sensitivity of Alpine tourism and the adaptive capacity of the tourism sector. The main focus lies on the institutional and cultural dimension of vulnerability. For the adaptive capacity assessment of the tourism sector a specific set of indicators for assessing adaptive capacity has been developed and a standardized survey has been conducted with representatives of public authorities and non-state organizations in all Alpine states. The case study therefore complements the pan-European vulnerability assessment conducted in ESPON Climate with a qualitative approach by integrating qualitative data into the indicator based overall methodology.

The results of the vulnerability assessment of Alpine tourism give a better understanding of the impacts of climate change on the tourism sector and the adaptive capacity of the studied tourism regions in the European Alps. The expected effects of changing climate stimuli on the tourism industry can be differentiated along the altitude of the European Alps: for high alpine summer tourism the increase in mean temperature and the number of summer days are expected to have a positive effect due to the freshness of summer resorts whereas for high alpine winter tourism a decreasing attractiveness of snow sport activities is expected because of a decrease in days with snow cover, shortening of the touristic season and an increasing occurrence of natural hazards. Rural tourism in lower mountain areas is expected to benefit in summer as a result of an increasing attractiveness of the lake regions. In winter medium and low lying tourism destinations are expected to have a significant decrease in snow reliability and length of season. In the lowlands of the European Alps especially city tourism will gain attractiveness due to a prolonging of the season and an increasing number of summer days.

Concerning the adaptive capacity of the tourism sector there are two fields of actions for enhancing the adaptation of tourism activities to climate change impacts across all Alpine regions: the informational basis available for decision-makers and the climate change awareness among tourism actors. In order to achieve well-informed decisions on adaptation activities in tourism regions and develop consistent and long-term strategies, region specific climate data as well as impact and vulnerability assessments are needed. Additionally, this information has to be made available for decision makers in the tourism sector. The second field of action concerns the

problem awareness among actors as precondition for realizing adaptation options and reducing vulnerability. The study shows that major efforts need to be made in the field of awareness raising and capacity building within the tourism sector. This includes actors from tourism economy as well as local providers, local population and guests.

2 Introduction

2.1 Characterization of the case study region Alpine Space

The European Alps are one of the largest continuous natural areas in continental Europe. According to the delimitation given in the Alpine Convention (cf. figure 1) the European Alps comprise an area of 190,000 square kilometers with a length of around 1,200 kilometers. Lying in the centre of Europe the Alps are shared by eight countries (Slovenia 3.6 % of the overall area, Austria 28.7 %, Italy 27.2 %, Germany 5.8 %, the Principality of Liechtenstein 0.08 %, Switzerland 13.2 %, France 21.4 % and Monaco 0.001 %). Most of the area is between 200 and 4,807 meter above sea level. As one of the largest natural areas in continental Europe the Alps are home to around 30,000 animal species and 13,000 plant species, many of which are endangered or endemic. Further, the Alps are crucial for water accumulation and water supply as most of the major European rivers (e.g. Danube, Po, Rhine, Rhone) have their headwaters in the Alps (Bicknell and McManus 2004).

The Alps are characterized by mostly rural areas, but many of its 14 million inhabitants live in 5,867 municipalities. The Alps cover 90 NUTS3 regions (cf. table 1). As a natural area that is shared by several countries there is a long tradition of international cooperation between public and private stakeholders working on transnational issues concerning the Alps, e.g. the Alpine Convention, the International Commission for the Protection of the Alps (CIPRA), the Alliance in the Alps and the Alpine Space Programme founded in the framework of the European Union cohesion policy.

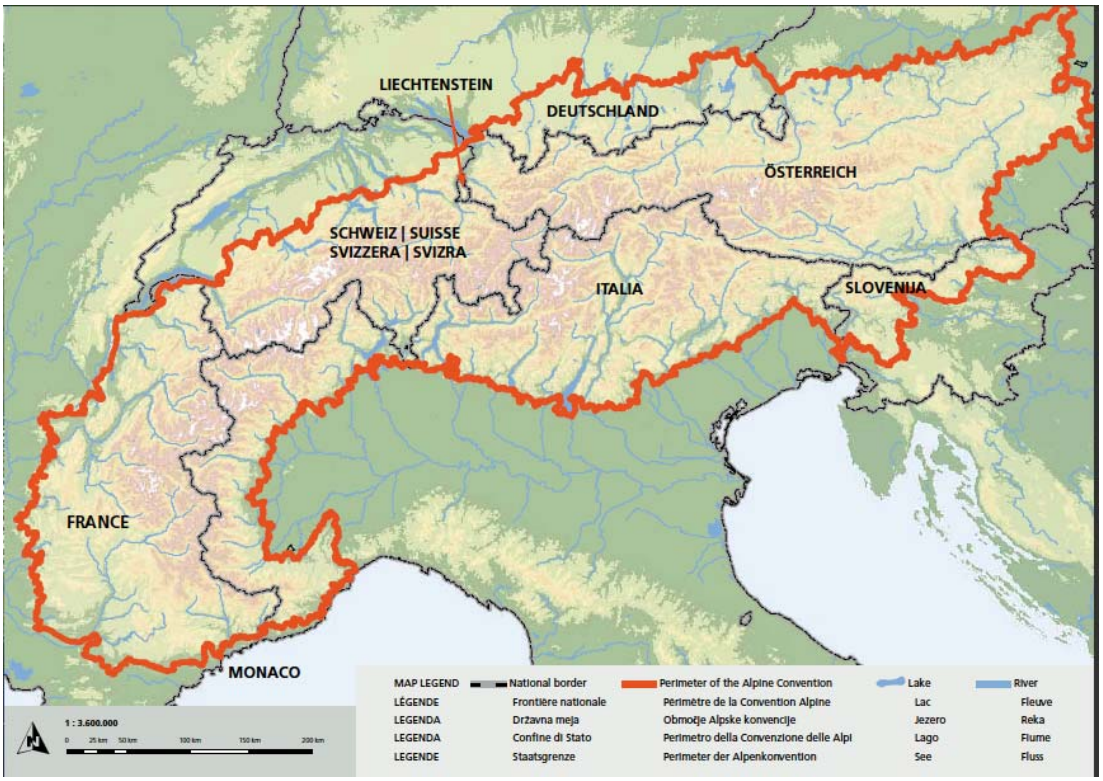


Figure 1: Perimeter of the Alpine Convention (source: Bicknell and McManus, 2004: 13)

Country	NUTS 1	NUTS 2	NUTS 3
Slovenia	Slovenia	Slovenia	Podravska, Koroška, Savinjska,Osrednjeslovenska, Gorenjska, Notranjsko-kraška, Goriška
Austria	Eastern Austria	Burgenland	Mittelburgenland, Nordburgenland, Südburgenland
		Lower Austria	Mostviertel-Eisenwurzen, Niederösterreich-Süd, Sankt Pölten, Wiener Umland/Nordteil, Wiener Umland/Südteil
	Southern Austria	Carinthia	Klagenfurt-Villach, Oberkärnten, Unterkärnten
		Styria	Graz, Liezen, Östliche Obersteiermark, Oststeiermark, West- und Südsteiermark, Westliche Obersteiermark
	Western Austria	Upper Austria	Steyr-Kirchdorf, Traunviertel
		Salzburg	Lungau, Pinzgau-Pongau, Salzburg und Umgebung
		Tyrol	Ausserfern, Innsbruck, Osttirol, Tiroler Oberland, Tiroler Unterland
		Vorarlberg	Bludenz-Bregenzerwald, Rheintal-Bodenseegebiet
Italy	Nord-Ovest	Piedmont	Torino, Vercelli, Novara, Cuneo, Biella, Verbania
		Valle d'Aosta	Valle d'Aosta
		Liguria	Imperia, Savona
	Lombardi	Lombardi	Varese, Como, Sondrio, Bergamo, Brescia, Lecco
	Nord-Est	Trentino-Alto Adige	Bolzano-Bozen, Trento
		Veneto	Verona, Vicenza, Belluno, Treviso
		Friuli-Venezia Giulia	Pordenone, Udine, Gorizia
Germany	Bavaria	Upper Bavaria	Rosenheim Krfr. Stadt, Bad Tölz-Wolfratshausen, Berchtesgadener Land, Garmisch-Partenkirchen, Miesbach, Rosenheim, Landkreis, Traunstein, Weilheim-Schongau
		Swabia	Kaufbeuren Krfr. Stadt, Kempten (Allgäu) Krfr. Stadt, Lindau (Bodensee), Oberallgäu, Ostallgäu
Liechtenstein	Liechtenstein	Liechtenstein	Liechtenstein
Switzerland	Switzerland	Switzerland	Appenzell I. Rh, Appenzell A. Rh, Bern, Fribourg, Glarus, Graubünden, Luzern, Nidwalden, Obwalden, St. Gallen, Schwyz, Tessin, Uri, Waadt, Wallis
France	Centre-Est Méditerranée	Rhône-Alpes	Drôme, Isère, Haute-Savoie, Savoie
		Provence-Alpes-Côte d'Azur	Alpes-de-Haute-Provence, Alpes-Maritimes, Var, Vaucluse, Hautes-Alpes
Monaco	Monaco	Monaco	Monaco

Table 1: NUTS Regions in the Alps (Allianz in den Alpen, o.J.)

2.2 Climate change in the Alpine Space

Already recently the climate in the European Alps has changed significantly and effected regions and local economies. Within the last 150 years climate change has already led to a significant increase in temperature of around + 2° C. This is more than twice the rate of average warming of the Northern hemisphere. This warming has led to a retreat of glaciers, change in seasonal mean temperature as well as precipitation patterns and a decline in snow cover (EEA, 2009). Future climate change, especially the increasing temperature and a higher variability of precipitation, will reinforce this development and modify today's living and working conditions (Beniston, 2005; ClimChAlp, 2008) . Natural hazards are inherent to an Alpine environment, e.g. rockfalls, debris flows, land slides, floods and avalanches. Also droughts and forest fires occur, especially in dry southern Alpine valleys. Rising temperature and changes in precipitation patterns are expected to modify the occurrence of natural hazards (Jetté-Nantel and Agrawala 2007) (cf. chapter 3).

In its White Paper on Adaptation to Climate Change the European Commission names the Alps as one of the areas in Europe most vulnerable to climate change impacts (Commission of the European communities, 2009: 4). Further, Alpine tourism is mentioned as one of the sectors most likely to be affected by the effects of climate change (Ibid.). Indeed, both summer and winter tourism have emerged as core economic sectors in the Alpine countries within the last 200 years. After the Mediterranean Region the Alps are the second most favoured holiday destination in Europe. With 60 million overnight guests tourism is in most rural and alpine regions in the European Alps the most important economic sector. At the same time tourism in the Alpine Region is highly weather and climate related. It is therefore one of the economic sectors most affected by changing climate stimuli (cf. chapter 4).

2.3 Aims and research questions

The aims of the case study within ESPON Climate are

- to cross-check the general appropriateness and feasibility of the selected indicators for the vulnerability assessment,
- to develop a better understanding of effects on regions against the background of European diversity and
- to explore the diversity of response approaches to climate change.

One main task of the case studies is to cover those dimensions of sensitivity and adaptive capacity with appropriate indicators and data where data for the whole ESPON area might not be available (especially cultural and institutional vulnerability). The regional case studies therefore are based on local knowledge and qualitative data. Moreover, the case studies combine existing and new ‘hard data’ with ‘soft data’ on the outlook and commitment of local and regional stakeholders.

Therefore, the case study ‘Alpine Space’ puts special emphasis on the assessment of the institutional and cultural dimension of vulnerability integrating qualitative data from the regional stakeholders. In order to understand and assess the institutional and cultural dimension of Alpine tourism as economic sector, the case study focuses on the capacities of Alpine regions to adapt tourism activities to expected climate change impacts. Further, it investigates current and potential proactive and long-term adaptation options within the tourism sector in the Alpine Region.

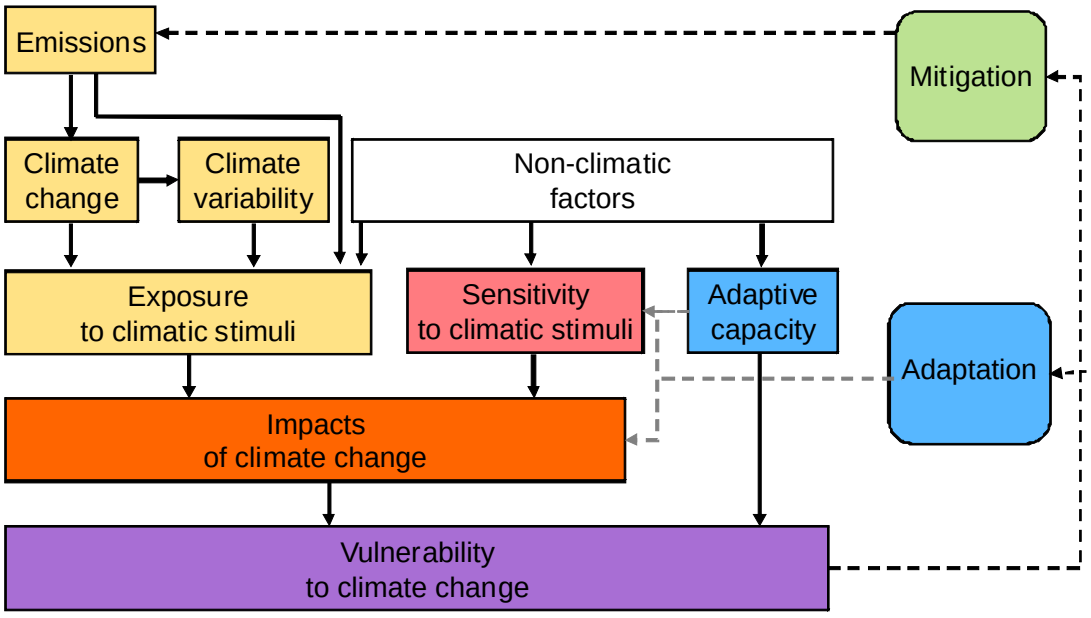
The main research questions are:

- How vulnerable is the tourism sector to climate change impacts in the European Alps?
- What characterizes the adaptive capacity of the tourism sector?
- Are there differences concerning the adaptive capacity between the Alpine states and regions?

As a first step, cause-effect relations between the exposure to climatic stimuli in the Alps and the regional as well as seasonal sensitivity of the tourism sector are investigated in detail. According to the research framework for assessing vulnerability (cf. chapter 2.4) exposure and sensitivity together specify the potential impact of climate change stimuli on tourism. These impacts can be linked to possible adaptation strategies and measures. Based on these impact chains, the adaptive capacity is evaluated along a modified set of indicators specific for Alpine tourism (cf. chapter 5).

2.4 Methodological framework

With this research structure the case study ‘Alpine Space’ follows the overall methodological framework of the ESPON Climate project, detailing and cross-checking findings of the pan-European exposure, sensitivity and adaptation analysis



(cf. figure 2).

The assessment of the vulnerability of Alpine tourism to climate change is following an indicator-based approach (cf. ESPON Climate, 2009). The set of indicators to assess exposure, sensitivity in its different dimensions (physical, environmental, economic, social, cultural) and adaptive capacity has been adapted to the specific research question concerning the vulnerability of Alpine tourism.

2.5 Methods

For the analysis of the adaptive capacity of tourism in the Alpine regions a semi-standardized survey has been conducted with representatives of public authorities for economic development, environmental agencies and spatial planning authorities as well as tourism organisations on both state and regional level, complemented by experts from international state and non-state organizations in all Alpine states (cf. chapter 5.1). It was not possible to cover all NUTS3 regions as the NUTS3 regions do not in all cases match the boundaries of administrative level of the

Figure 2: ESPON Climate Change research framework

cantons/Länder/provinces on the one hand and the tourism regions on the other hand. Within the Alpine Space 34 administrative regions in five countries were examined, three countries were studied on the national level (cf. table 2).

National Level	**Regional Level**
Switzerland	Eastern Switzerland (St. Gallen, Appenzell Ausser and Inner Rhoden, Glarus), Berne, Grisons, Central Switzerland (Lucerne, Schwyz, Obwalden, Nidwalden, Uri), Valais, Vaud, Fribourg, Ticino
Liechtenstein	Liechtenstein
Austria	Burgenland, Carinthia, Lower Austria, Upper Austria, Salzburg, Styria, Tyrol, Vorarlberg
Germany	Bavaria
France	Alpes-Maritimes, Alpes de Haute-Provence, La Drôme, Hautes-Alpes, Haute-Savoie, Isère, Savoy, Var, Vaucluse
Monaco	Monaco
Italy	Friulia Venezia Giulia, Lombardy, Liguria, Piedmont, Trentino, Bolzano, Aosta, Venetia
Slovenia	Slovenia

Table 2: Investigated administrative regions of the Alpine Space

The survey was conducted online with the possibility to instead answer a print version of the questionnaire. From the 193 experts who have been asked to answer the survey 94 participants have responded.

The questionnaire covered different aspects: the relevance and expected impacts of climate change on the region and the tourism sector, current and potential adaptation measures, knowledge and information on climate change issues, the organizational structure of the tourism sector and socio-demographical details. The focus of interest laid on the judgments and opinion of the experts. (cf. questionnaire in the annex A).

This qualitative approach is seen as complementary to the statistical approach of the pan-European analysis.[1]

3 Exposure: Changing climate in the Alpine Space

Exposure to climate stimuli represents the nature and degree to which a system is exposed to climatic variations. The Alps have undergone an exceptionally high temperature increase of around + 2° C between the late 19th and early 21st century. This is more than twice the rate of average warming of the Northern hemisphere. Furthermore, a slight trend towards an increase in precipitation in the north and a decrease the south alpine region has been recorded (EEA, 2009: 22 ff.).

Climate change scenarios based on Regional Climate Models (RCM) project continuously rising temperatures for the Alps up until the end of the 21st century (between + 2.6° C and + 3.9° C), with an accelerated increase in the second half of the century (Amelung and Moreno, 2009; EEA, 2009). As in the past, the Alps will be exposed to a stronger warming than the rest of Europe. According to a study of the European Environmental Agency temperature will rise particularly in the high mountains (> 1500 m) with an increase of 4.2°C (cf. figure 3).

[1] Results of both approaches will be compared and discussed in the final report.

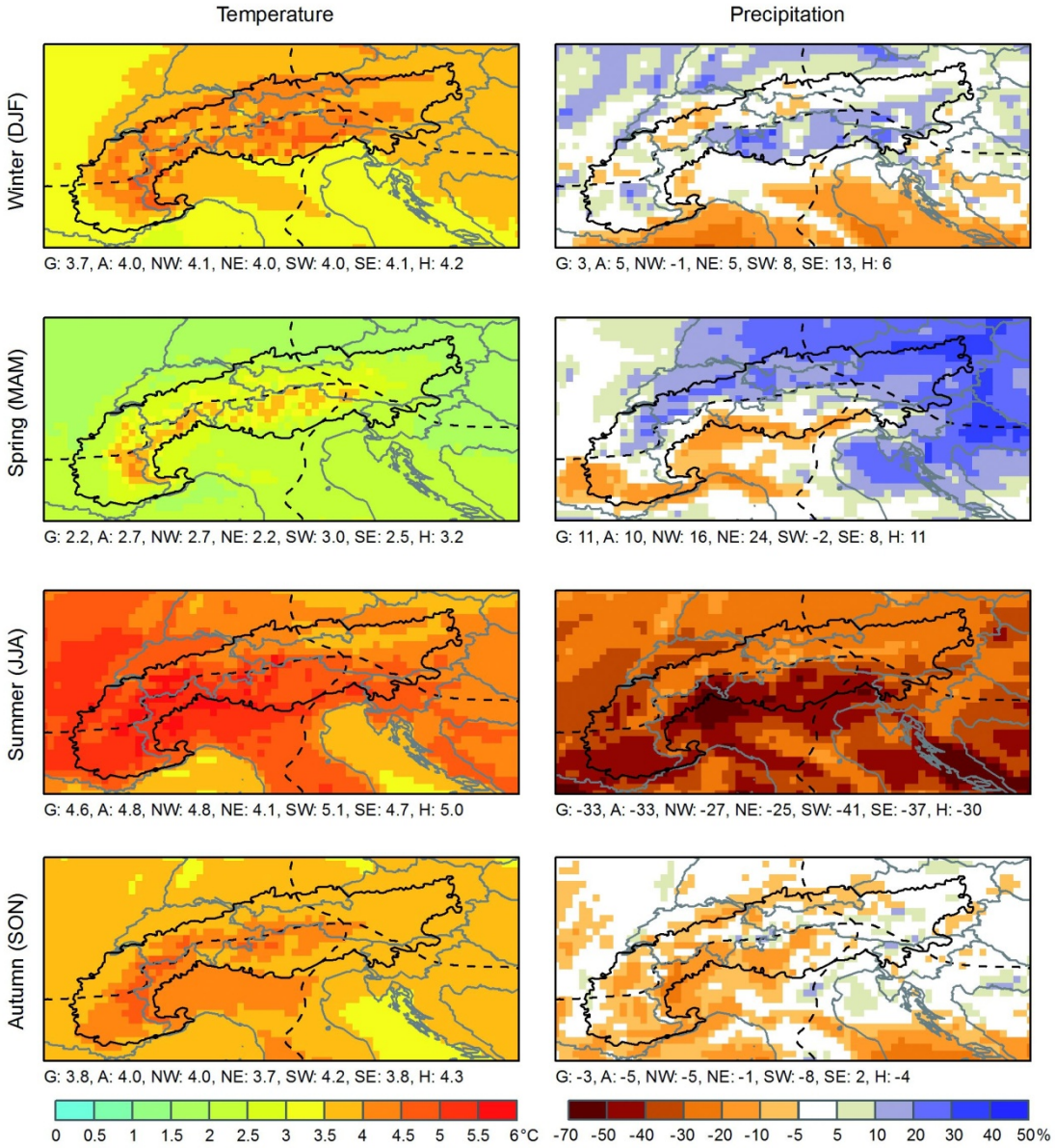


Figure 3: Seasonal changes in precipitation and temperature up until the end of the 21st century, according to CLM scenario A1B (source: EEA, 2009: 27)

Note: Left: absolute difference in temperature. Right: relative difference in precipitation. Regional statistics: G = Greater Alpine Region, A = Alps, NW = north-western Alps, NE = north-eastern Alps, SW = south-western Alps, SE = south-eastern Alps, H = higher than 1 500 m. Seasons are: Winter (December, January, February) Spring (March, April, May), Summer (June, July, August), Autumn (September, October, November).
Source: EURAC, 2008, based on data from CLM climate scenarios (Lautenschalger *et al.*, 2008).

Projected changes in precipitation are moderate in terms of the yearly total, but show significant changes within the seasons, mainly a decrease in summer precipitation and, in most regions, an increase in spring and winter precipitation. The scenarios show an exception in the Southern Alps where we can find an increase in precipitation in the winter season. In general, precipitation in winter is expected to increasingly fall as rain rather than snow, leading to fewer days with snow cover. Corresponding with these changes in precipitation and snow cover, an increase in winter run-off and a decrease in summer run-off will be enhanced (cf. figure 3 and 4).

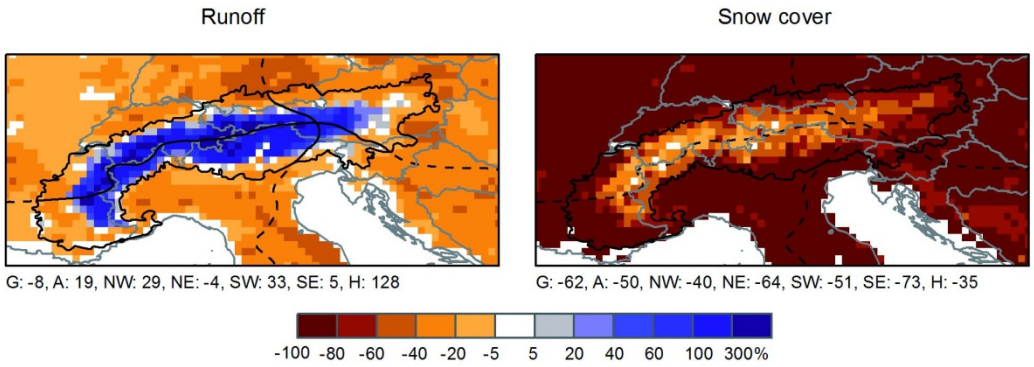


Figure 4: Run-off and snow cover change up until the end of the 21st century in winter, according to the CLM A1B scenario (source: EEA 2009, 29)

Note: Left: relative difference in water available for run-off. Right: relative difference in days with snow cover. Regional statistics: G = Greater Alpine Region, A = Alps, NW = north-western Alps, NE = north-eastern Alps, SW = south-western Alps, SE = south-eastern Alps, H = higher than 1 500 m.
Source: EURAC, 2008, based on data from CLM climate scenarios (Lautenschalger et al., 2008).

These further increases in temperature and a higher variability of precipitation are expected to result in changes of glaciers, permafrost zones, water scarcity in summer and reduced snow reliability in winter months. The occurrence of alpine hazards (e.g. avalanches, land slides) is also forecasted to increase significantly (EEA, 2009: 27). Especially the frequency and magnitude of permafrost and glacier related hazards, like debris flow, rock falls and outburst floods of glacial lakes, are expected to increase (Jetté-Nantel and Agrawala 2007). Also the number of forest fires and drought and low-flow conditions are expected to increase with rising temperatures (Schumacher and Bugmann 2006; Vanham, Fleischhacker et al. 2009). Floods as being influenced by changing precipitation patterns would have high economic impacts in the lower mountain range and low lands of the Alpine arc. At the same time studies basing on a set of model runs of different regional climatic models (RCM) and their driving general circulation model (GCM) as well as applying more than one scenario come to the conclusion that precipitation is, compared to temperature less robust and reliable in the Alpine region (EURAC, 2009). Further, different GCMs produce partly contrasting patterns of spatial distribution of precipitation. This shows that even though a lot of effort is invested to gain reliable regional projections, results based on only one model and scenario type should be handled with care.

4 Sensitivity: Alpine tourism

Climate change sensitivity is understood as the degree to which a system is affected, either adversely or beneficially, by climate related stimuli. The focus of the case study 'Alpine Space' lies on Alpine tourism as economic sector. The most important impact of the different climatic stimuli on Alpine tourism is an indirect one: the change of

attractiveness. Climatic stimuli are not directly influencing the economic performance of the tourism sector, but are affecting physical, environmental, cultural or social conditions on which Alpine tourism is directly depending on (cf. ESPON Climate, 2009: 32 ff.).

4.1 Tourism in the European Alps

The Alps are — after the Mediterranean coast — the second most favoured holiday destination in Europe (EEA, 2003).This means that more than 60 million overnight guests (four times the local population) frequent the Alps every year. In 2005, 475 million overnight stays were registered and 7 million bed-places were available (Kämpf and Hunziker, 2008). According to the OECD, the tourism sector provides 10–12 % of jobs in the Alps (OECD, 2007). Summer tourism has stagnated since the early 1970s whereas winter tourism has expanded significantly, compensating for weak tourist numbers during summer. With an annual turnover of 50 billion EUR, the winter tourism industry contributes significantly to the Alps' economy (Ibid.). The Alps are home to more than 600 ski resorts and 10'000 ski installations of which 85 % are in France, Switzerland, Austria and Italy (Ibid.).

4.2 Alpine tourism and climate change

Tourism in the Alps can be divided in different touristic zones, which are affected by climate change differently. Studies on Alpine tourism differentiate between *city tourism* and *rural tourism*, which includes touristic activities at the foothill of the Alps or in lower altitudes, and *high alpine tourism* in higher altitudes. Apart from these touristic zones the touristic seasons of winter and summer need to be considered when assessing the impact of climate stimuli on tourism (Bürki, 2000; OECD, 2007; Pröbstl, 2007).

Tourism is only indirectly affected by climatic stimuli. Expected secondary effects from changing climatic stimuli relevant for alpine tourism are the following (OECD, 2007; Teich, Lardelli et al., 2007; Steiger and Mayer, 2008; EEA, 2009):

- Decrease in *snow reliability* which is influenced by winter precipitation and number of frost days. These main climatic stimuli influences the days of snow fall as well as the amount and number of days with snow cover. Expected impacts on winter tourism are that service providers are moving to higher elevations and seeking for technical adaptation measures, e.g. artificial snow production.
- Retreat of *glaciers*, mainly influenced by the number of frost days, changes in mean summer and winter temperature as well as winter precipitation. Expected impacts are a change in water run-off and, especially relevant for winter and summer tourism, a change in landscape scenery.
- Thawing *permafrost* due to a rise in mean temperature and the increasing number of summer days. Expected impacts are increasing insecurity of

infrastructure in permafrost zones and a rising risk of landslides and rock falls affecting transport infrastructure in high altitude and outdoor tourism.

- Some studies also expect an increasing risk of *extreme events*, such as heat waves, droughts and heavy precipitation/floods. Impacts for tourism infrastructure and touristic offers are difficult to estimate. Negative impacts of water scarcity are expected for water-dependent touristic offers (e.g. spa and wellness tourism) and water supply for artificial snow production. Heat waves are rather considered to affect city and beach tourism around Alpine lakes positively. Mountainous destinations are expected to profit from the cooling effect of higher altitude in summer.

Generally speaking previous studies expect an increasing attractiveness of summer tourism due to more summer days and a longer season; and a decreasing attractiveness of winter tourism due to a decrease in snow cover, shorter season and an increasing risk of natural hazards. However, detailed cause-effect relationships between climatic stimuli and regional as well as seasonal sensitive sectors and zones have still to be investigated.

4.3 General sensitivity assessment

Considering the seasonality of tourism, climatic stimuli which are expected to change due to climate change have different effects on summer and winter tourism. Table 3 lists the eight exposure indicators used for the pan-European exposure analysis within ESPON Climate and relates them to Alpine summer and winter tourism (cf. ESPON Climate, 2010: 45). This gives a first overview of the exposure-sensitivity relations mentioned in the section above.

Economic sensitivity	**Climatic stimuli**								**Triggered climate effects**	
	Change in annual **mean temperature**	Decrease in number of **frost days**	Change in number of **summer days**	Change in mean **winter precipitation**	Change in mean **summer precipitation**	Change in number of **heavy rainfall days**	Change in annual **mean evaporation**	Change in number of **days with snow cover**	Change in occurrence of **river flooding**	Change of **mean sea level**
Summer tourism	x		x		x				x	
Winter tourism	x	x		x				x		

Table 3: Economic sensitivity of Alpine tourism related to climatic stimuli and triggered climate effects (cf. ESPON Climate, 2010: 45)

Adding the dimension of touristic zones to seasonal tourism a differentiated picture of adversary and beneficiary expected effects can be drawn (cf. table 4).

	Summer tourism	Winter tourism
City tourism	Increasing attractiveness due to more summer days, prolonging season	none
Rural tourism	Increasing attractiveness of lake regions	Decreasing attractiveness due to lack of snow cover
High alpine tourism	Increasing attractiveness due to freshness of summer resorts	Decreasing attractiveness due to lack of snow cover, shorter season, natural hazards

Table 4: Expected effects of changing climate stimuli on different touristic zones and seasons

5 Adaptive Capacity: Options and capacities of alpine tourism to adapt to climate change

Based on the analysis of exposure to climatic stimuli within the European Alps and the sensitivity of Alpine tourism, possible adaptation strategies and measures can be related to the potential impacts of climate change in the tourism sector. Current studies discuss a broad range of autonomous and planned adaptation strategies, varying from short-term reactions, technical adaptation (artificial snow production) and economic risk reduction through organizational measures to long-term adaptation strategies, like diversification of touristic offers (especially in summer tourism), spatial expansion and concentration of winter tourism in high altitudes or retreat from touristic sites which are not cost efficient (cf. table 5; also see Bürki, 2000; Kämpf and Hunziker, 2008; Steiger and Mayer, 2008).

For putting adaptation options into practice the adaptive capacity of a region or an economic sector is most relevant. Adaptive capacity is defined as the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behavior and in resources and technologies (IPCC, 2007; ESPON Climate, 2009: 62).

As one of the tasks of the case studies within ESPON Climate is to focus on institutional dimensions of vulnerability, the case study ‘Alpine Space’ concentrated on assessing the adaptive capacity of Alpine tourism, with a special focus on the determinants ‘knowledge and awareness’, ‘institutions’ and ‘economic resources’. With this in-depth analysis the case study makes a contribution to cross-checking the

pan-European methodology and refining results, maps and policy recommendations on the European level.[2]

Adaptation options for Alpine Tourism	
Promoting innovation and diversification of tourism offers	• Creation of new summer attractions • Development of Spa programs and promotion of health specific aspects
Further developing and securing of snow sports activities	• Extension of existing ski areas to higher elevations • Building of new high-altitude ski areas • Cooperation or merger of cableway companies • Securing snow-reliability by using additional snow making equipment • Construction of reservoirs for water supply of artificial snowmaking • Promotion of glacier skiing
Promoting all year tourism	• Withdrawal from ski tourism in ski areas at lower elevations • Development of all year tourism offers that are climate and weather independent • Increasing the attractiveness of the region by emphasising regional specialities • Improving of learning opportunities and cultural offers • Inform tourists about climate change impacts
Other adaptation options	• Use of insurance instruments • Improving natural hazards Management • Monitoring the impacts of climate change on the tourism sector • Promoting research and development projects in order to actively participate in climate change adaptation of tourism

Table 5: Current and future adaptation options for Alpine tourism

5.1 Assessing adaptive capacity of Alpine tourism – Methodology and Methods

5.1.1 Methodology

The general methodological framework of ESPON Climate suggests to operationalize the concept of adaptive capacity based on five determinants: knowledge and awareness, technology, infrastructure, institutions and economic resources (cf. ESPON Climate, 2009: 67).

Some determinants are generic in that they enable adaptation across localities and countries. In order to measure adaptive capacity across regions, indicators have to be specified to describe the different aspects of the determinant. Most of the preliminary indicators, which have been suggested for assessing the adaptive capacity across regions (Ibid.: 64 ff.), are proxy indicators and not climate change specific. In order to assess adaptive capacity of a specific economic sector in a specific region – of tourism in the Alpine space – most of the suggested indicators are to general. Communication uptake or the number of patents, for example, do not seem to be specifically relevant for the tourism sector in the Alpine space. Therefore,

[2] The results of the pan-European vulnerability analysis will be cross-checked and compared to the case study analysis for the final report.

one goal of the case study was to develop sector and region specific indicators along the suggested methodology of five determinants of adaptive capacity.

Another challenge for specifying the methodology was to integrate qualitative indicators. As the tourism sector in the Alpine space is a very heterogenic and diversified economic sector in terms of touristic offers, revenues and subsidies, it is difficult to use statistical indicators covering the whole Alpine space, which encompasses eight countries and 90 NUTS3 regions.

Therefore, we have adapted the set of determinants from the pan-European analysis and supplemented it with qualitative indicators (cf. chapter 5.2). The qualitative data to measure the indicators have been surveyed specifically for the ESPON Climate project.

5.1.2 Methods

For the analysis of the adaptive capacity of tourism in Alpine regions a *semi-standardized expert survey* has been conducted. In each region representatives of public authorities for economic development, environmental agencies and spatial planning authorities as well as tourism organizations on both state and regional level have been asked to participate in the survey. Between three and five experts per region have been contacted. On transnational level experts from international state and non-state organizations in all Alpine states have participated. The participants have been identified through internet searches or personal recommendation. If possible experts who work in the field of climate adaptation and/or tourism have been contacted directly. If experts could not be identified in advance, the request has been sent to the mail centre of the organisation. This occurred only in few cases.

The survey was conducted online with the possibility to instead answer a print version of the questionnaire (for a sample of the online survey see annex B). The participants have been contacted first by email in order to introduce the project and explain the goals and procedure of the survey. One week later the URL-link for the online-survey has been sent to them by email. Only few experts preferred to fill in the print version instead of the online survey. From 193 experts that have been contacted and invited to answer the survey 94 participants have responded. This gives a response rate of 48.7 %.

The survey has been conducted in all eight Alpine countries. Therefore, the questionnaire has been translated in four languages (English, German, French and Italian). The Slovenian participants have received the questionnaire in English. This did not seem to be a problem as all five experts, who received the questionnaire, participated in the survey.

The questionnaire covered different aspects: the relevance and expected impacts of climate change on the region and the tourism sector, current and potential adaptation measures, knowledge and information on climate change issues, the organizational structure of the tourism sector and socio-demographical details. In order to gain

regional knowledge, the focus of interest laid on the judgments and opinion of the experts. The questionnaire contained single and multiple choice questions as well as open text questions where the participants were encouraged to answer at length (cf. questionnaire in the annex A.1).

As it is the aim of the case study to focus on the institutional dimension of adaptive capacity and to cover the regional response to climate change in the tourism sector of both administrative as well as cooperative actors, NUTS3 level as unit of analysis could not be realized consistently. One reason is that the administrative and political units of the Alpine countries do not in all cases match the NUTS3 territory. The second reason is that tourism regions and their organizations do not always match the administrative and statistical regions. Therefore, the survey was mostly conducted with experts on the level of Länder/Cantons/Provinces/ Departments. In Switzerland this corresponds to NUTS 3, in Austria and Italy to NUTS2, and in Germany to NUTS1. In Liechtenstein (NUTS1/NUTS2/NUTS3), Monaco (NUTS1/NUTS2/NUTS3) and Slovenia (NUTS1/NUTS2) only the national level has been considered (for more details on the administrative and statistical perimeter of the regions as well as on the participating organizations and the number of responses per region see annex C). For the analysis of the survey data some NUTS3 regions in Switzerland have been grouped together, as some tourism organizations cover several smaller Cantons (e.g. Eastern Switzerland covers Appenzell Ausser Rhoden, Appenzell Inner Rhoden, Glarus and St. Gallen).

5.2 Specifying adaptive capacity indicators for Alpine tourism

The indicators that have been surveyed in the questionnaire are based on the set of determinants for adaptive capacity (cf. figure 5).

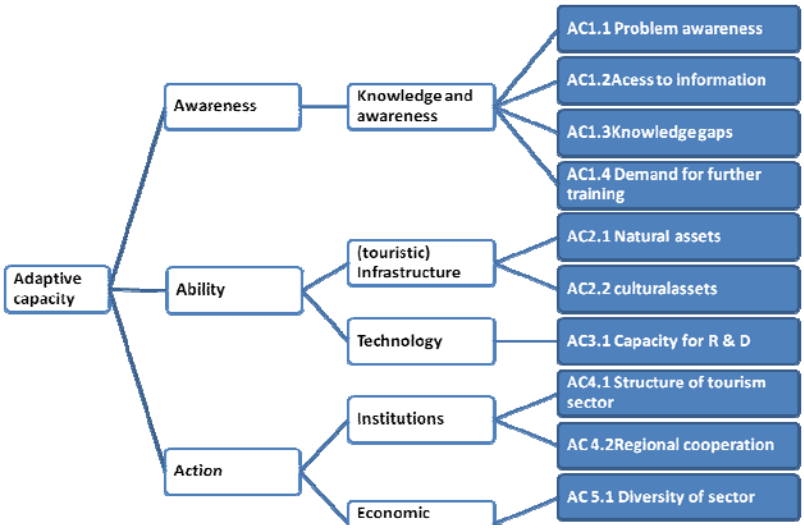


Figure 5: Specified set of indicators for assessing adaptive capacity of Alpine tourism

The determinant *'knowledge and awareness'* is operationalized by four qualitative indicators:

- problem awareness (AC1.1)
- access to information (AC1.2)
- knowledge gaps (AC1.3)
- demand for further training (AC1.4).

The underlying assumptions are that (a) regions with a high problem awareness concerning climate change impacts in their own region have a higher adaptive capacity, (b) regions where information about climate change impacts is available and (c) where an awareness of knowledge gaps exists, have a higher adaptive capacity, as well as (d) the demand for further education/professional training about possible courses of action concerning adaptation to climate change is a first step for adaptation activities (Hoffmann et al., 2009). For detailed weighting of the different items and the aggregation of the four indicators see annex D.1.

The determinant '*infrastructure*' is operationalized by two indicators:

- natural assets (AC2.1),
- cultural assets (AC2.2).

The underlying assumption is that regions with a significant proportion of natural assets as well as cultural assets have a higher potential for diversifying their touristic offers in summer and all-year tourism (Loibl/Walz 2010).

The determinant '*technology*' is described by only one indicator:

- capacity for research and development (AC3.1).

We assume that regions, which already have invested in research and development in the field of adaption tourism to climate change, have a higher adaptive capacity than regions that have not yet invested in research and development in the field of climate change adaptation (Brooks et al., 2005).

The determinant '*institutions*' is operationalized by two indicators:

- structure of tourism sector (AC4.1),
- regional cooperation (AC4.2).

The underlying assumptions are that (a) tourism organizations, which are divided into few big sections, have a higher adaptive capacity than tourism organization divided into small sections and (b) tourism organizations that have intensive cooperation with local/regional/national authorities have a higher adaptive capacity than tourism organization with low cooperation activities (Kämpf and Weber, 2005).

The determinant '*economic resources*' is measured along the following indicators:

- Diversity of sector (AC5.1),

- Capacity for innovation (AC5.2).

The assumptions are that (a) the more diverse the tourism sector is, the higher the adaptive capacity, (b) if winter tourism is contributing to the added value of a region in a high extent, the adaptive capacity is diminished, and (c) the more innovative the tourism offers are, the higher is the adaptive capacity (Ibid.).

The indicators are measured using different kind of survey questions (closed/open questions, single/multiple choice questions, three or five level Likert scale). Many of the questions are based on the self-estimation and expert opinion of the representatives. All scores have been normalized on a range from 0 (lowest level) to 10 (highest level) in order to enable an aggregation of the different items.[3]

The aggregation of the different indicators within each determinant was achieved by equal weighting. For details on the description, calculation and aggregation of the indicators used, refer to annex D.1.

Due to time restrictions the analysis of adaptive capacity, which was conducted in the case study, contains some limitations:

Some determinants are only scarcely described by a single or few indicators (infrastructure/technology). The suggested indicators from the pan-European assessment were only little convenient to describe the adaptive capacity of the tourism sector (e.g. the number of patents per region cannot be used as proxy indicator for the adaptive capacity of Alpine tourism). Especially the determinants 'technology' and 'infrastructure' are not described sufficiently, yet. Therefore, further studies need to develop specific indicators for these determinants in the field of mountain tourism.

To anticipate this shortcoming for the current analysis and to prevent that a single determinant is mal-represented, we did not use weighting for the overall aggregation of all five determinants based on the expert Delphi (cf. annex D2). However, as the expert Delphi conducted within ESPON Climate suggested almost equal weighting, we suggest to have the two determinants which are not very strongly represented, 'infrastructure' and 'technology' with 5 % each and the other determinants 'knowledge and awareness', 'institutions' and economic resources' with 30 % each. This weighting could be changed if additional data supported indicators are integrated in the assessment of adaptive capacity in the Alpine tourism in further studies.

In order to survey the already realized and potential adaptation options, questions were added where the expert could choose between a selection of adaptation options and add additional ones (see Question B3-B6 in Annex A.2). Further, the experts were asked to rank the realized and potential adaptation options according to their effectiveness. The hypothesis behind these items are that (a) regions where adaptation activities already have been implemented, have a higher adaptive

[3] We calculated two versions: a normal version and a benchmark version (see annex E.1 and E.2)

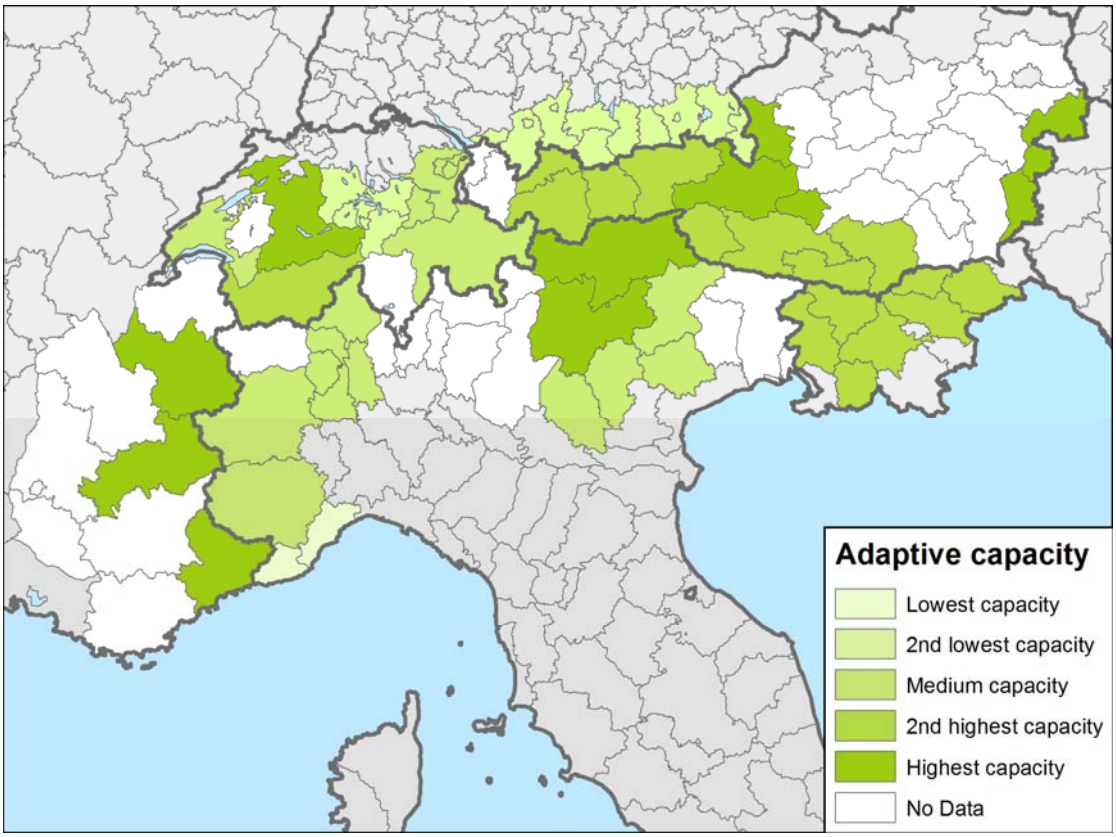
capacity, (b) regions that have implemented adaptation strategies, do not have a high adaptive capacity per se, moreover, regions implementing long-term adaptation strategies, have a higher adaptive capacity than regions implementing short-term adaptation options and (c) the more adaptation options exist in a region, the higher is the region's adaptive capacity to climate change.

Finally, we integrated two questions as control questions concerning the self-estimation of adaptive capacity (control question 1) and the willingness to adapt (control question 2). This is based on the assumption that the higher the awareness of the own adaptive capacity and the higher the willingness to implement adaptation measures is in a region, the higher is the capacity to realize adaptation options (cf. annex D.1).

5.3 Results of adaptive capacity assessment: regional spotlights

The results show a differentiated picture of strength and weaknesses concerning the five adaptive capacity determinants. The following presentation of results of the adaptive capacity assessment focuses on the top seven and bottom seven scores within the main determinants ‘knowledge and awareness’ (AC1), ‘institutions’ (AC4) and ‘economic resources’ (AC5). In addition, the aggregated score (ACges) is examined.[4] The results for each indicator as well as the aggregated score for each determinant are documented in annex E.

[4] If questions were not answered by any expert in a particular region they were marked as missings (NA) and could not be included for the calculation of indicators. As missings cannot be aggregated the aggregated score ACges contains quite a few missings, we have only results for 20 regions. For the indicators AC1 we have results for 20 regions, AC2 25 regions and AC5 29 regions.



Map 1: Adaptive capacity in the Alps: Overall results of the survey

For *Switzerland* fifteen Cantons have been contacted for the survey and from all at least one questionnaire was returned. Berne is under the top seven among all Alpine regions concerning the overall score for adaptive capacity as well as for the determinant 'knowledge and awareness'. Additionally, in the self-assessment of adaptive capacity (control question 1) Berne reaches one of the highest scores among all regions. Also among the top seven are Valais and Ticino concerning the 'institutions' (AC4). Eastern Switzerland, Central Switzerland, Valais and Vaud are among the bottom seven concerning 'knowledge and awareness'.

In the Austrian part of the Alps eight Bundesländer have been contacted. There was no reply received from Voralberg. Among the other regions, Burgenland and Salzburg are under the top seven among all regions of the Alpine space for the aggregated score (ACges). Concerning the determinant 'knowledge and awareness' (AC1) Salzburg and Tirol are leading the score, due to a rather high problem awareness of climate change impacts on tourism in the respective region, the reflection of existing knowledge gaps, the demand for further information and training for actors from the tourism sector. With regard to the determinant 'institutions' (AC4) the regions Carinthia, Tirol and Upper Austria are under the top seven whereas Styria is among the bottom seven. For the determinant 'economic resources' (AC5) Burgenland, Lower Austria and Upper Austria are under the top scores mainly due to their capacity for innovation and their low dependency on winter tourism, whereas Tirol and Styria are in the lowest range as in both regions winter tourism is economically most important and at the same time the tourism sector is considered

to be not very innovative. Both in combination leads to a low adaptive capacity regarding the economic resources. At the same time both Tirol and Styria consider the capacity of tourism to adapt to climate change impacts as high (control question 1).

For *Germany* Bavaria was assessed. All experts who were contacted participated in the survey. The results show a rather high problem awareness in the upper middle range compared to other regions in the Alpine space. Especially the access to information is evaluated rather positive as regional climate change scenarios and vulnerability assessments are available. The tourism offers are diverse and winter tourism is subordinate for the regional tourism economy.

In the *French* part of the Alps all nine departments have been contacted for the survey. We did not receive any reply from experts from Alpes-de-Haute-Provence, Isère, Var and Vaucluse. The departments Alpes-Maritimes and Savoye are among the top seven of all Alpine regions. Alpes-Maritimes and Hautes-Alpes gained high scores in the determinant 'knowledge and awareness' (AC1), especially due to a sufficient knowledge and information base on regional level (e.g. regional climate change scenarios are available). Additionally, different measures to overcome knowledge gaps and to enhance professional training on climate issues within the tourism sector have been realized. The department Alpes-Maritimes and Drôme received high scores in the determinant 'economic resources' (AC5). The tourism offers are very diverse and winter tourism is not among the main important economic driver for tourism in the three departments.

In the *Italian* part of the Alps seven provinces have been contacted. From Friulia Venezia Giulia we have received no answers. Trentino Alto Adige is under the top seven of all Alpine regions in the overall adaptive capacity score (ACges) as well as in the score for 'knowledge and awareness' (AC1) and 'institutions' (AC4). The information available is considered as sufficient for taking action and reaches from national and regional climate change scenarios to climate impact studies and vulnerability assessments. The experts state that not additional information is needed, but a higher acceptance of climate change activities by the touristic actors. The main issue of further training should therefore be to raise problem awareness within the tourism sector. The tourism sector in Trentino Alto Adige is enough diverse, but winter tourism contributes the highest share to the economic value within the tourism sector.

From *Slovenia* experts from the national level participated in the survey. The scores do not show Slovenia under the top seven, but in the upper middle range of all Alpine regions concerning the overall score of adaptive capacity. In the field of 'knowledge and awareness' (AC1) Slovenia is under the highest scores, especially because of a good informational basis and a high awareness where the knowledge gaps are located. A main challenge for enhancing adaptive capacity is seen in the awareness raising and education of tourism actors and identifying financial support for realizing adaptation activities in the tourism sector.

From *Monaco* we received only one reply, which, moreover, contained some missings. Therefore no aggregated score could be calculated. In comparison with the other Alpine regions Monaco has a high score concerning the self-assessment of adaptive capacity, but a rather low score in 'problem awareness' (AC1.1), 'access to information' (AC1.2) and institutions (AC4). The results have to be seen against the background that Monaco has a very small territory. Thus, it is dependent on regional climate data and scenarios from the surrounding countries and regions (especially France). Nevertheless, Monaco has a quite diversified tourism sector, which is mostly dependent on not-climate dependent form of tourism such as congress tourism, cultural tourism and event trips. Together with a rather innovative tourism sector this leads to a high score for the determinant 'economic resources'.

For *Liechtenstein* as a small country the informational basis for taking adaptation options is a major challenge and only considered as partly sufficient. At the same time the tourism economy relies mainly on revenues from winter tourism and the tourism sector is considered to be not so innovative. Therefore, the aggregated score for adaptive capacity of Liechtenstein is rather low compared to other Alpine regions.

5.4 Transnational conclusions

Comparing the data from all Alpine regions two issues can be highlighted:

- Most of the regions consider the information on climate change issues relevant for the tourism sector as not or only partly sufficient for realizing adaptation measures. When asked which information is missing to realize adaptation measures in the tourism sector, most experts mention local or *regional specific information,* such as regional climate scenarios and vulnerability assessments.
- Another issue that comes up in many regions when being asked what additional activities should be realized in order to increase the adaptive capacity of the tourism sector, is first of all *raising awareness of climate* change impacts among tourism actors (tourism industry, guests, local population). Other activities to foster adaptive capacities are to create *financial support for innovative tourism* offers and to launch long-term strategies in the tourism sector.

6 Vulnerability of Alpine Tourism

Climatic stimuli are expected to change significantly until the end of the 21st century in the European Alps. Relevant for Alpine tourism as an important sector for regional and local economies in the Alpine Space are an expected increase in mean summer and winter temperature, an increase in the number of summer days, a change in mean winter precipitation and the number of days with snow cover.

Climatic stimuli are not directly influencing the economic performance of the tourism sector, but are affecting physical, environmental, cultural or social conditions on which Alpine tourism is directly depending on. As Alpine tourism is at least up to now mainly divided in summer tourism and winter tourism, climatic changes in summer temperature and precipitation as well as winter temperature and precipitation are most relevant for Alpine regions.

The effect of changing climate stimuli on alpine tourism offers can be differentiated along the altitude of mountainous areas: for high alpine summer tourism climate change is expected to have a positive effect due to the freshness of summer resorts whereas for high alpine winter tourism a decreasing attractiveness of snow sport activities is expected due to the decreasing number of days with snow cover, shortening of the touristic season and the increasing risk of natural hazards. Rural tourism in lower mountain areas is expected to benefit in summer due to an increasing attractiveness of the lake regions. In winter medium and low lying tourism destinations are expected to have a significant decrease in snow reliability and therefore the length of the winter season. In the lowlands of the European Alps especially city tourism will gain attractiveness due to a prolonging of the season and the increasing number of summer days.

The results of the empirical part of the case study ‘Alpine Space’ give a better understanding of the impacts of climate change on the tourism sector and the adaptive capacity of the studied tourism regions in the European Alps. One lesson that can be drawn from the results is that there are two fields of actions for adapting the tourism sector to climate change impacts across all Alpine countries: (1) the available informational basis and (2) the climate change awareness among tourism actors.

(1) In order to develop consistent and long-term adaptation strategies for tourism regions, region specific climate data as well as impact and vulnerability assessments are needed. This information needs to be made available for decision makers in the tourism sector.

(2) The second field of action concerns the problem awareness among actors as precondition for realizing adaptation options and reducing vulnerability. The study shows that major effort needs to be made in the field of awareness raising and capacity building within the tourism sector, including actors from the tourism economy as well as local providers, local population and guests.

On the methodological level the case study contributes to specifying the overall methodological framework for assessing adaptive capacity as central element of vulnerability assessments. The case study gives an example of how to collect and integrate qualitative data into the indicator-based framework of vulnerability assessment.

6.1 Strategies and policy development

The adaptive capacity of the tourism sector in the Alpine Space and possible strategies for reducing vulnerability of Alpine tourism are embedded in regional, national and international strategies and policy development in the field of adaptation and mitigation of climate change impacts. Next to national policy development, the Alpine space being shared by several countries is imbedded in a long tradition of transnational cooperation. International organizations like the Alpine Convention, the Alliance in the Alps and the International Commission for the Protection of the Alps (CIPRA) as well as Research Programmes like the Alpine Space Programme founded in the framework of the European Union cohesion policy work on strategies and policy development in the field of climate change.

Both national and transnational policies can in different ways contribute to adapt to and manage climate change impacts that cannot be avoided:

- Develop adaptation strategies to address vulnerabilities,
- Raise awareness to climate change impacts and adaptation measures,
- Encourage 'climate friendly' and 'climate proof' development,
- Provide support in developing adaptive capacity,
- Detect and influence key actors in the field of climate change,
- Provide relevant policy tools for climate proofing, climate risk analysis and adaptation by design,
- Create information platforms on climate change and adaptation to climate change,
- Incentivize and support regions to adapt to climate change,
- Seek funding to implement adaptation projects and
- Coordinate political lobbying for adaptation mainstreaming.

6.2 New opportunities through adaptation and mitigation

There are a lot of new opportunities for forward looking European regions in the wake of climate change through adaptation and mitigation. In the field of climate change adaptation, new development opportunities include new innovative tourism offers that attract tourist. Alternative offers that depend less on snow reliability and inexpensive infrastructure, like guided snowshoe or summer hiking treks, are additional ways to attract tourists. Nonetheless, in low-altitude winter sport destinations attractive snow-independent offers, such as indoor activities, are in demand. In addition, a high diversification of the offers is recommended. Regarding climate change mitigation, new development opportunities consist of new attractive tourism offers that reduce CO_2 emissions. Good examples are unique eco-friendly destinations like the Alpine

Pearls (OECD, 2007; Permanent Secretary of the Alpine Convention, 2008; UNEP, 2008).

6.3 Adaptation strategies

6.3.1 Adaptation strategies on transnational level

Regarding adaptation strategies, the Alpine Convention developed the Action Plan on climate change in the Alps. The territorial dimension of this Action Plan is delimited by the perimeter of the Alpine Convention (cf. figure 1). In March 2009 the Action Plan on Climate Change in the Alps was adopted by the Xth Alpine Conference. The strategy will be implemented by the Alpine Convention, the Working Groups which are set for a 2-year-term, the Platforms of the Alpine Convention and the contracting parties that include the eight Alpine States (Switzerland, Austria, Germany, Slovenia, Monaco, France, Italy, Liechtenstein). The contracting parties have to take necessary measures to involve local and regional authorities in this Action Plan (Permanent Secretary of the Alpine Convention, 2009).

The Action Plan on Climate Change in the Alps addresses mainly the following sectors: Spatial and land planning, energy, transport (shift traffic towards eco- and climate-friendly means of transportation), tourism, enhancement of mountain forests and development of forestry, preservation of biodiversity, water and water resources, mountain farming, applied research and awareness raising (Annex G gives a detailed overview of the sectors addressed by the Action Plan on Climate Change in the Alps) (Permanent Secretary of the Alpine Convention, 2009).

6.3.2 Adaptation strategies on national level

Regarding national adaptation strategies most countries in the Alpine Space have already adopted or are currently developing adaptation strategies for their country. In many countries (e.g. Switzerland and Germany) adaptation policies have been or are being developed in a ‘top-down’ manner, from a scientific perspective, responding to concerns about global climate change. Other countries (e.g. Austria) involved local stakeholders in the development of their adaptation strategy. The development of an adaptation strategy using a ‘bottom-up’ approach is much more time-consuming and therefore more expensive to implement (PEER, 2009). In some national adaptation strategies tourism has been listed as a relevant sector for climate change adaptation, as it is e.g. the case in Portugal, Spain, Finland, Sweden, UK and Germany. Especially the Scandinavian countries expect benefits from climate change in the tourism sector. Mediteranean countries however expect problems in other related sectors, such as e.g. water resources. As the PEER Report does not examine the national adaptation strategies of any Alpine country, the issue of Alpine tourism and climate change adaptation has still not been taken into consideration by comparative adaptation policy studies, yet.

6.4 Assessment of costs and benefits of climate change

None of the adaptation strategies described above addresses costs and benefits of climate change impacts on different sectors. Overall, there are few studies on economic impacts, including the impact on tourism. For the Italian Alps the Fondazione Eni Enrico Mattei (FEEM) (FEEM Fondazione Eni Enrici Mattei, 2008) published a study on costs of climate change impacts and adaptation strategies.

7 Discussion

7.1 Reflection of methodological framework

On the basis of the methodological framework for the assessment of vulnerability of European regions and regional economies, we developed a specified set of indicators for the assessment of Alpine tourism as one of the most important economic sectors within the European Alps. It turned out to be feasible to use the main determinants of the general framework and adapt the specific indicators for measuring to the conditions of Alpine tourism. This enabled an in-depth analysis, which would not have been achieved on the pan-European level.

Another challenge we had to take within the case study 'Alpine Space' was to include qualitative data and expert views as we attempted to focus on the institutional and cultural dimension of vulnerability. The conducted survey produced a lot of structured qualitative data, which was normalized on a score from 0 to 10. As qualitative data cannot be measured in the same way as quantitative data, not the absolute scores are of relevance for the analysis but the relation among the regions under study. Further research should be conducted on describing additional indicators, especially for the determinants 'technology' and 'infrastructure'. A further step would be to integrate qualitative data with quantitative data. The results based on the conducted survey may at the moment only state a tendency about the adaptive capacity and needs to be complemented with further data and additional indicators. This would help to produce more robust results.

Finally, the weighting of the different determinants could be revised on the basis of an expert Delphi among tourism experts.

7.2 Discussion of validity of European-wide analysis

The qualitative approach of the case study 'Alpine Space' is seen as complementary to the statistical approach of the pan-European analysis. Thus, a cross-check of the qualitative and region-specific results from the case study 'Alpine Space' and quantitative the pan-European analysis is difficult. Nonetheless, the general picture of the European assessment, which ranks Austria's, Germany's, Slovenia's and partly French's adaptive capacity rather high goes in line with the qualitative assessment of this case study. Though, the differences among the regions are not well represented

well. This is especially the case for Italy as for the pan-European assessment a lot of data for Italy exists only on national level. The biggest difference is reflected in the case of the Italian province Trentino Alto Adige which specific capacities to adapt to climate induced impacts on tourism and land management are not well reflected in the pan-European. Trentino Alto Adige has the special situation that it is on the one hand already today highly exposed to natural hazards and expects a high increase in impact of climate change (cf. impact maps of the pan-European Assessment). On the other hand, the province has a high autonomy from the Italian national government both in legal and economic terms. Trentino Alto Adige has established a very effective management of natural hazards and land use development over the last decades, and thus built up a high capacity in terms of climate relevant knowledge as well as research and implementation of climate adaptation options in land use management (e.g. in form of the Hazard Zone Plan). This is not represented in the general indicators of adaptive capacity (e.g. government effectiveness on national level) used for the pan-European assessment. The expected high increase of climate change impacts and high vulnerability of the province though is well represented in the pan-European impact and vulnerability maps.

7.3 Transferability of results of the case study to other regions

When transferring results or methodology of an indicator based assessment to other regions it is always necessary to check and if necessary to adapt the chosen indicators to specific regional conditions. For the case study Alpine Space it seems possible to transfer some of the indicators and the operationalization in form of the survey to other mountain regions in Europe (e.g. the Pyrenees) and elsewhere where the regional economy is also highly dependent on the tourism sector and as part of it on winter tourism. The specified set of indicators might also be applicable to arctic regions, which are highly dependent on winter tourism (Hall/Saarinen 2010).

In order to transfer the methodology to regions, which are highly dependent on tourism but generate most of their yearly revenues in summer (e.g. Mediterranean regions), some indicators would have to be revised (Perch-Nielsen, 2008: 39 ff.).

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ESPON Climate
Final Report

Climate change adaptation and Tourism in the Alpine Space

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Annex

A Questionnaire

A.1 Example of print Questionnaire (Excerpts from the German version)

BEDEUTUNG UND AUSWIRKUNGEN DES KLIMAWANDELS

1. Für wie relevant halten Sie die Auswirkungen des Klimawandels auf den Alpenraum?

- ☐ überhaupt nicht relevant
- ☐ eher nicht relevant
- ☐ teils/teils
- ☐ eher relevant
- ☐ sehr relevant
- ☐ keine Angaben

2. Für wie relevant halten Sie die Auswirkungen des Klimawandels auf Ihre Region?

- ☐ überhaupt nicht relevant
- ☐ eher nicht relevant
- ☐ teils/teils
- ☐ eher relevant
- ☐ sehr relevant
- ☐ keine Angaben

3. Uns interessiert Ihre Meinung. ***Bitte markieren Sie inwieweit Sie den folgenden Aussagen zustimmen.***

3.1. Die Auswirkungen des Klimawandels führen bereits heute weltweit zu Problemen.

- ☐ stimme überhaupt nicht zu
- ☐ stimme eher nicht zu
- ☐ teils/teils
- ☐ stimme eher zu
- ☐ stimme voll und ganz zu
- ☐ keine Angaben

3.2. Die Auswirkungen des Klimawandels werden in Zukunft weltweit zu Problemen führen.

- ☐ stimme überhaupt nicht zu
- ☐ stimme eher nicht zu
- ☐ teils/teils
- ☐ stimme eher zu
- ☐ stimme voll und ganz zu
- ☐ keine Angaben

7. Es werden bereits eine Reihe von Anpassungsstrategien des Tourismus an die Folgen des Klimawandels diskutiert.

Bitte wählen Sie aus der folgenden Liste diejenigen Anpassungsaktivitäten aus, die in Ihrer Region in der **Vergangenheit** realisiert worden sind oder **derzeit** umgesetzt werden. *Mehrfachnennungen möglich*

- ☐ **Förderung von Innovation und Diversifikation des touristischen Angebots**
  - ☐ Neue Sommerattraktionen schaffen
  - ☐ Wellness-Angebote ausbauen und gesundheitsfördernde Aspekte gezielt bewerben
- ☐ **Weiterentwickeln und Sichern des Schneesports**
  - ☐ Hochgelegene Gebiete ausbauen
  - ☐ Hochgelegene Gebiete neu erschliessen
  - ☐ Fusion von Bergbahngesellschaften
  - ☐ Schneesicherheit mit zusätzlichen Beschneiungsanlagen sichern
  - ☐ Bauen von Speicherseen für Wasservorräte zur künstlichen Beschneiung
  - ☐ Förderung von Gletscherskitourismus
- ☐ **Förderung von Ganzjahrestourismus**
  - ☐ Aufgabe von niedrig gelegenen Skigebieten
  - ☐ Ausbau wetterunabhängiger Ganzjahresangebote
  - ☐ Erhöhung der Attraktivität der Region durch Betonung regionaler Besonderheiten
  - ☐ Verbesserung von Bildungs- und Kulturangeboten
  - ☐ Aufklärung und Informieren der Touristen/innen über Folgen des Klimawandels
- ☐ **Nutzung von Versicherungsinstrumenten**
- ☐ **Verbesserung des Naturgefahrenmanagements**
- ☐ **Auswirkungen der Klimaveränderung auf den Tourismus beobachten** (Monitoring)
- ☐ **Forschungs- und Entwicklungsprojekte** fördern, um sich aktiv an der Klimaanpassung des Tourismus zu beteiligen
- ☐ **Andere:**

A.2 Coding of items

A Relevance and impacts of climate change

A1 In your opinion, how relevant are the impacts of climate change on the Alpine space? (Aa1)
not relevant at all (0)
not so relevant (1)
partly relevant (2)
quite relevant (3)
very relevant (4)
not specified (-1)

A2 In your opinion, how important are the impacts of climate change on your region? (Aa2)
not relevant at all (0)
not so relevant (1)
partly relevant (2)
quite relevant (3)
very relevant (4)
not specified (-1)

A3 We are interested in your opinion. Please indicate to what extent you agree with the following statements. (Aa3)
strongly disagree (0)
disagree (1)
neither disagree nor agree (2)
agree (3)
strongly agree (4)
not specified (-1)

- The impacts of climate change are already today causing global problems. **(Frage 3.1, Aa3 1)**
- The impacts of climate change will in future lead to global problems. **(Frage 3.2, Aa3 2)**
- The impacts of climate change are already today causing problems in our region. **(Frage 3.3, Aa3 3)**
- The impacts of climate change will in future lead to problems in our region. **(Frage 3.4, Aa3 4)**

A4 What changes from climate change do you expect in your region *by 2030*? (Aa4)
Please mark all changes that you expect for your region with a cross.

- Increase in mean annual temperature **(Aa4 1)** (1)
- Rising temperature in summer **(Aa4 2)** (1)

- Rising temperature in winter **(Aa4 3)** (1)
- Increase in number of summer days (>25°C) **(Aa4 4)** (1)
- Decrease in precipitation in summer (March to September) **(Aa4 5)** (1)
- Increase in precipitation in winter (October to April) **(Aa4 6)** (1)
- Decrease in water availability **(Aa4 7)** (1)
- Increase of extreme events (e.g. storms, mass movements such as debris flows, heavy rainfall events, floods, heat waves) **(Aa4 8)** (1)
- Decrease in snow-reliability **(Aa4 9)** (1)
- Shrinking glaciers and melting permafrost **(Aa4 10)** (1)
- Change of tourist seasons (e.g. shorter winter season) **(Aa4 11)** (1)
- Occurrence of previously unknown diseases **(Aa4 12)** (1)
- Changes in flora and fauna **(Aa4 13)** (1)
- Others: **(Aa4 14)** (Text)

B Adaptation to climate change in the tourism sector

B1 We are interested in your opinion. Please indicate to what extent you agree with the following statements. (Bb1)
strongly disagree (0)
disagree (1)
neither disagree nor agree (2)
agree (3)
strongly agree (4)
not specified (-1)

- The impacts of climate change will in future not lead to problems in tourism in our region. **(Bb1 1)**
- The impacts of climate change will in future lead to problems in tourism in our region. **(Bb1 2)**
- The impacts of climate change will lead in future to problems in winter tourism in our region. **(Bb1 3)**
- The impacts of climate change will in future lead to problems in summer tourism in our region. **(Bb1 4)**
- It would be sensible to already today realise measures to prevent negative consequences of climate change for tourism in our region. **(Bb1 5)**

B2 What activities have already been implemented in your region to adapt the tourism sector to the impacts of climate change? (Bb2)

B3 A set of activities to adapt the tourism sector to the impact of climate change is being discussed.(Bb3)

Please select from the following list those adaptation activities that were implemented in the **past** or are **currently** being implemented. *Multiple responses are possible*

- Promoting innovation and diversification of tourism offers **(Bb3 10) +**
  - Creation of new summer attractions **(Bb3 11) +**
  - Development of Spa programs and promotion of health specific aspects **(Bb3 12) +**
- Further developing and securing of snow sports activities **(Bb3 20)**
  - Extension of existing ski areas to higher elevations **(Bb3 21) 0**
  - Building of new high-altitude ski areas **(Bb3 22) 0**
  - Cooperation or merger of cableway companies **(Bb3 23) +**
  - Securing snow-reliability by using additional snow making equipment **(Bb3 24) -**
  - Construction of reservoirs for water supply of artificial snowmaking **(Bb3 25) -**
  - Promotion of glacier skiing **(Bb3 26) -**
- Promoting all year tourism **(Bb3 30) +**
  - Withdrawal from ski tourism in ski areas at lower elevations **(Bb3 31)+**
  - Development of all year tourism offers that are climate and weather independent **(Bb3 32) +**
  - Increasing the attractiveness of the region by emphasising regional specialities **(Bb3 33) +**
  - Improving of learning opportunities and cultural offers **(Bb3 34) +**
  - Inform tourists about climate change impacts **(Bb3 35) +**
- Use of insurance instruments (**Bb3 40) +**
- Improving natural hazards Management **(Bb3 50) +**
- Monitoring the impacts of climate change on the tourism sector (**Bb3 60) +**
- Promoting research and development projects in order to actively participate in climate change adaptation of tourism **(Bb3 70) +** AC2
- Others: **(Bb3 80)** (Text)

B4 Which of the activities that have been implemented in your region do you consider as most effective? (Frage 8, Bb4) *AO1, Adaptation Options (realised)*

Please select from the following list max. **three options** in the order of their importance.

1. Option **(Bb4 1)**
2. Option **(Bb4 2)**

3. Option **(Bb4 3)**

B5 Which other adaptation activities or strategies do you think are feasible in the tourism sector of your region *by 2020*? (Bb5) *Multiple responses are possible*

B6 In your opinion, on which activities the tourism sector in your region should focus to adapt to climate change? (Bb6)
Please select from the following list max. **three options** in the order of their importance.

1. Option **(Bb6 1)**
2. Option **(Bb6 2)**
3. Option **(Bb6 3)**

C Knowledge and information

C1 From which sources do you get information about climate change and possible adaptation strategies and activities? (Cc1)
Multiple responses are possible

- Newspaper (**Cc1 1) +**
- Radio **(Cc1 2) +**
- Television **(Cc1 3) +**
- Academic journals **(Cc1 4) ++**
- Internal sources of information (e.g. company magazine, newsletters) **(Cc1 5) ++**
- National climate change scenarios **(Cc1 6) ++**
- Regional climate change scenarios **(Cc1 7) +++**
- Climate impact studies **(Cc1 8) +++**
- Vulnerability assessments **(Cc1 9) +++**
- Database of historical climate records **(Cc1 10) ++**
- Records of extreme events **(Cc1 11) ++**
- Hazard and risk maps **(Cc1 12) ++**
- Others: **(Cc1 13)** (Text) **++**_____

C2 Is the available information about the impacts of climate change on your region sufficient to realise activities to adapt to climate change? (Cc2)
not sufficient (0)
partly sufficient (1)
sufficient (2)
not specified (-1)

C3 Which information is missing to realise activities to adapt to climate change? (Cc3) (Text)

C4 On what issues would professional training in the field of "climate change adaptation and tourism" be necessary? (Cc4) (Text)

D Adaptive capacity of the tourism sector to climate change

D1 How do you assess the capacity of tourism to adapt to climate change impacts in your region? (Dd1)
no adaptive capacity at all (0)
low adaptive capacity (1)
some adaptive capacity (2)
high adaptive capacity (3)
very high adaptive capacity (4)
not specified (-1)

D2 What additional activities should be realised to increase the adaptive capacity of tourism to the impacts of climate change in your region? (Dd2) (Text)

E Structure and potential of the tourism sector

E1 Organisation of the tourism sector
How is the tourism sector structured in your region? (Ee1)
Multiple responses are possible

- Umbrella organisation **(Ee1 1) +**
- Divided into small sections **(Ee1 2) -**
- Divided into few big sections **(Ee1 3) +**
- Specialised **(Ee1 4) -**
- Diversified **(Ee1 5) +**
- Predominantly public **(Ee1 6) 0**
- Predominantly private **(Ee1 7) 0**
- Other structure: **(Ee1 8)** (Text)_____

E2 Tourism offers

E2a What different forms of tourism are offered in your region? (Ee2a) *Multiple responses are possible*

- Beach holiday **(Ee2a 1)**
- Countryside/farm holiday (agri-tourism) **(Ee2a 2)**
- Event trips (e.g. museums, exhibitions, theme parks) **(Ee2a 3)**
- Congress tourism **(Ee2a 4)**
- Cultural tourism **(Ee2a 5)**
- Health and Spa tourism **(Ee2a 6)**
- Mountain Biking **(Ee2a 7)**
- Hiking **(Ee2a 8)**
- Water sports **(Ee2a 9)**

- Winter sports **(Ee2a 10)**
- Others: **(Ee2a 11)** (Text)
  _____

E2b Please indicate the tourism forms that contribute most to the added value of your region. (Ee2b)
Please select from the following list max. **three options** in the order of their importance.

1. Option **(Ee2b 1)**
2. Option **(Ee2b 2)**
3. Option **(Ee2b 3)**

E3 Innovation in tourism
E3a How innovative are the tourism offers in your region? (Ee3a)
not innovative at all (0)
not so innovative (1)
partly innovative (2)
quite innovative (3)
very innovative (4)
not specified (-1)

E3b Please indicate some innovative tourism products from your region. (Ee3b) (Text)

E4 Attractiveness of the region
E4a How do you rate the attractiveness of the natural environment of your region for tourism? (Ee4a)
very unattractive (0)
quite unattractive (1)
neither unattractive nor attractive (2)
quite attractive (3)
very attractive (4)
not specified (-1)

E4b How do you rate the cultural attractiveness of your region for tourism? (Ee4b)
very unattractive (0)
quite unattractive (1)
neither unattractive nor attractive (2)
quite attractive (3)
very attractive (4)
not specified (-1)

E5 Merger of tourism organisations
Have any tourism organisations merged in your region in the last 20 years? (Ee5)
Yes (0)
No (1)
Not specified (-1)

E6 Cooperation of tourism organisations with authorities and the local economy (e.g. supply services, retail industry, building industry etc.)
How intensive is the cooperation between tourism organisation, the authorities (e.g. spatial planning, environmental and economic agencies) and the local economies? (Ee6)

- No cooperation at all (0)
- Low cooperation (1)
- Some cooperation (2)
- Intensive cooperation (3)
- Very intensive cooperation (4)
- Not specified (-1)

F Personal details

- Sex (M/W) **(F1)**
- Age **(F2)**
  <20 (0)
  20-29 (1)
  30-39 (2)
  40-49 (3)
  50-59 (4)
  >60 (5)
- Function **(F3)**
  Directorate (0)
  Head of department/section (1)
  Administrator (2)
  Other: (3)

B Example of online survey

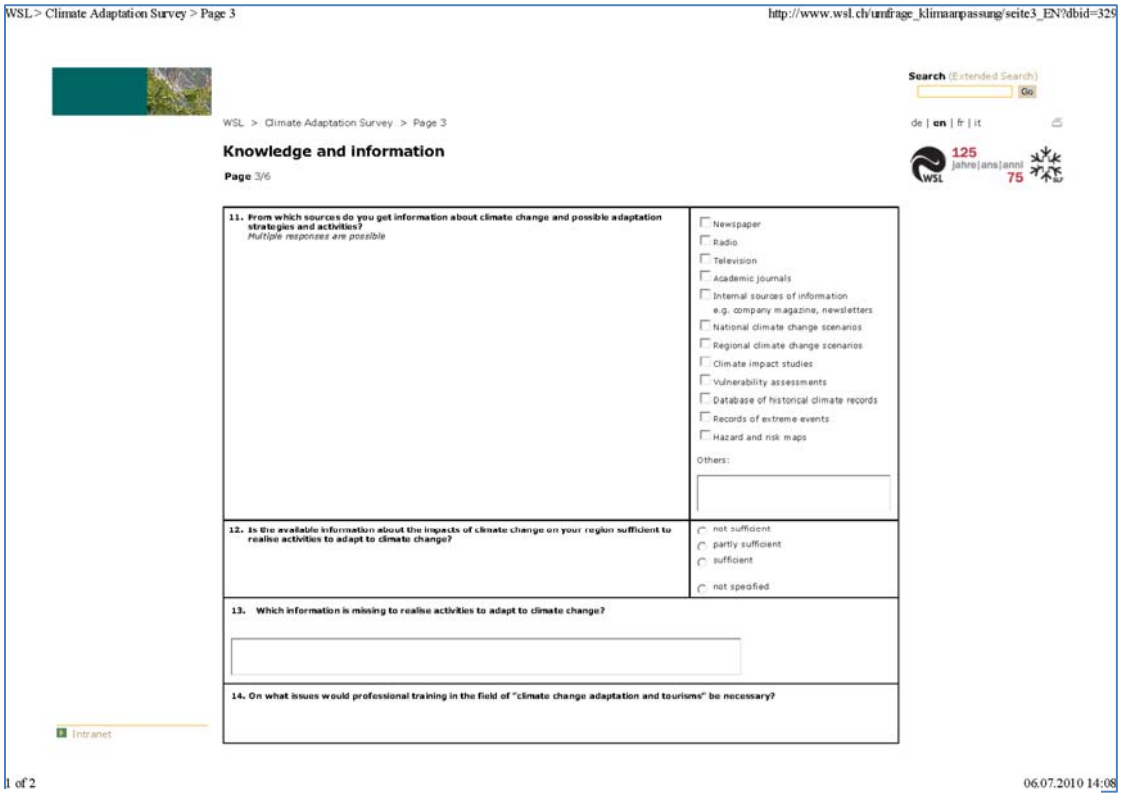

Figure 6: Example of online survey (English version)

C List of Participants and regions

RegID	Country	NUTS Level	Administrative Region	Authority/Organisation	No. of responses
	International				
Int				Alpine Convention (Alpenkonvention)	1
				CIPRA	1
				ARGE ALP	0
				Alpenforschungsinstitut	1
	Switzerland				
Chges	Switzerland	NUTS1/NUTS2		ARE (Bundesamt für Raumentwicklung)	1
				BAFU (Bundesamt für Umwelt)	1
				SECO (Staatssekretariat für Wirtschaft)	2
				Schweiz Tourismus	0
				Schweizer Tourismus-Verband	1
Chost	Eastern Switzerland	NUTS3	Appenzell Ausser Rhoden	Planungsamt	1
				Amt für Umwelt	1
				Departement Volks- und Landwirtschaft	0
				Ostschweiz Tourismus	1
Chost		NUTS3	Appenzell Inner Rhoden	Amt für Raumentwicklung	1
				Amt für Umweltschutz	0
				Volkswirtschaftsdepartement	1
Chost		NUTS3	Glarus	Hochbauamt	0
				Abteilung Umweltschutz und Energie	0
				Kontaktstelle für Wirtschaft	1
Chost		NUTS3	St. Gallen	Amt für Raumentwicklung und Geoinformation	1
				Amt für Umwelt und Energie	1
				Amt für Wirtschaft des Kantons St. Gallen	1
Chbe		NUTS3	Berne	Amt für Gemeinden und Raumordnung	1
				AUE (Amt für Umweltkoordination und Energie)	0
				BECO (Volkwirtschaftsdirektion)	1
CHbr		NUTS3	Grisons	Amt für Raumentwicklung	1
				Amt für Natur und Umwelt	1
				Amt für Wirtschaft und Tourismus	1
				Graubünden Tourismus	0
CHzch	Central Switzerland	NUTS3	Lucerne	Amt für Raumentwicklung, Wirtschaftsförderung und Geoinformation	1
				Amt für Umwelt und Energie (UWE)	1
CHzch		NUTS3	Nidwalden	Amt für Raumentwicklung	1
				Amt für Umwelt	0
				Amt für Wirtschafts- und Standortentwicklung	0
CHzch		NUTS3	Obwalden	Amt für Raumentwicklung und Verkehr	1
				Amt für Landwirtschaft und Umwelt	1
				Volkswirtschaftsdepartement	1
CHzch		NUTS3	Schwyz	Amt für Raumentwicklung	1
				Amt für Umweltschutz	1
				Amt für Wirtschaft	1
CHzch		NUTS3	Uri	Amt für Raumentwicklung	0
				Amt für Umweltschutz	1
				Volkswirtschaftsdirektion Tourismus	1
				Zentralschweiz Tourismus	0
CHvs		NUTS3	Valais	Dienstelle für Raumentwickung	1
				Service de la protection de l'environnement	1
				Service de promotion touristique et économique du Canton du Valais	1
				Wallis Tourismus	1
CHvd	CHvd	NUTS3	Vaud	Service de l'aménagement du territoire	1
				Service de l'environnement et de l'énergie (SEVEN)	1
				Service de l'économie, du logement et du tourisme	1
				Office du tourisme du Canton de Vaud	1
CHfr	CHfr	NUTS3	Fribourg	Bau- und Raumplanungsamt (BRPA)	0
				Service de l'Environnement	1
				Promotion économique du canton de Fribourg	0
				Freiburg Tourismus	0
Chti	Chti	NUTS3	Tessin	Ufficio della pianificazione locale	0
				Ufficio dell'aria, del clima e delle energie rinnovabili	1
				Ufficio delle regioni di montagna	0
				Privates Raumplanungsbüro	1
				Ticino Turismo	1
	Liechtenstein				
Lges		NUTS1/NUTS2/NUTS3	Liechtenstein	Stabstelle für Landesplanung	1
				Umweltministerium	*
				Amt für Umweltschutz	*
				Amt für Volkswirtschaft	1
				Liechtenstein Tourismus	*
				not identified answers	2
	Austria				
Ages	Autria			Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft	0
				Umweltbundesamt	1
				Bundesministerium für Wirtschaft, Familie und Jugend	1
				Wirtschaftskammer Österreich	0
				Österreich Werbung (ÖW)	0
Aburg		NUTS2	Burgenland	Burgenländische Landesregierung; Stabstelle Raumordnung und Wohnbauförderung	0
				Burgenländische Landesregierung; Amt für Umweltschutz	0
				Burgenländische Landesregierung; Abteilung für Tourismus	1
				Burgenland Tourismus	0
Akae		NUTS2	Carinthia	Institut für Raumordnung, Raumentwicklung, Naturschutz & EU-Programmabwicklung	1
				Institut für Raumordnung, Raumentwicklung, Naturschutz & EU-Programmabwicklung	1
				Kärntner Institut für Klimaschutz (KIKS)	0
				Kärntner Landesregierung; Finanzen, Wirtschaft, Wohnungs-und Siedlungswesen	0
				Kärnten Werbung, Marketing und Innovationsmanagement	0
Anoe		NUTS2	Lower Austria	Nö Landesregierung; Abteilung Raumordnung und Regionalpolitik	0
				Nö Landesregierung; Abteilung Umweltwirtschaft und Raumordnungsförderung	0
				Nö Landesregierung; Abteilung Umweltwirtschaft und Raumordnungsförderung	1
				Nö Landesregierung; Abteilung Wirtschaft, Tourismus und Technologie	1
				Niederösterreich-Werbung GmbH	0
Anoe		NUTS2	Upper Austria	Oberösterreichische Landesregierung;, Abteilung Raumordnung	1
				Oberösterreichische Landesregierung; Abteilung Umweltschutz	0
				Oberösterreichische Landesregierung; Abteilung Wirtschaft	0
				Oberösterreich Tourismus	1
Asalz		NUTS2	Salzburg	Land Salzburg; Amt für Raumplanung	1
				Land Salzburg; Amt für Umweltschutz	1
				Land Salzburg; Fachbereich Tourismus	0
				Salzburger Land Tourismus GmbH	0
Astei		NUTS2	Styria	Steiermärkische Landesregierung; Amt für Raumplanung	0
				Steiermärkische Landesregierun;, Umwelt- und Anlagenrecht	0

Table 6: List of regions and participants (part 1)

				Steiermärkische Landesregierung; Fachabt. Energiewirtschaft und allgm. techn. Anglh.	1
				Steiermärkische Landesregierung; Sport und Tourismus	0
				Steirische Tourismus GmbH	0
Atirol		NUTS2	Tyrol	Tiroler Landesregierung; Abteilung Raumordnung	1
				Tiroler Landesregierung; Abteilung Umweltschutz	0
				Tiroler Landesregierung; Abteilung Tourismus	0
				Tirol Werbung GmbH	0
NA		NUTS2	Vorarlberg	Vorarlberger Landesregierung; Abteilung Raumplanung und Baurecht	0
				Vorarlberger Landesregierung; Abteilung Umweltschutz	0
				Vorarlberger Landesregierung; Abteilung allgm Wirtschaftsangelegenheiten-Tourismus	0
				Vorarlberg Tourismus	0
	Germany				
DEges	Germany			BBSR	1
				Umweltbundesamt	0
				Bundesministerium für Wirtschaft und Technologie	0
				Deutsche Zentrale für Tourismus e.V. (DZT)	0
DEbay		NUTS1	Bavaria	Bayerisches Staatsministerium für Wirtschaft, Infrastruktur, Verkehr und Technologie	1
				Bayerisches Staatsministerium für Umwelt und Gesundheit	1
				Bayerisches Landesamt für Umwelt	1
				Bayerisches Staatsministerium für Wirtschaft, Infrastruktur, Verkehr und Technologie	1
				Bayern Tourismus Marketing GmbH	1
	France				
FRges	France			Ministère de l'Écologie, de l'Énergie du Développement durable et de la Mer, Energie et Climat	2
				Service Tourisme, commerce, artisanat et services	0
				Maison de la France	0
FRam		NUTS3	Alpes-Maritimes	Conseil général des Alpes-Maritimes; Service Aménagement	0
				Conseil général des Alpes-Maritimes; Service Aménagement	1
				Provence-Alpes-Côte-Azur Tourisme	0
KA		NUTS3	Alpes-de-Haute-Provence	Conseil général des Alpes de Haute-Provence; Urbanisme, Habitat et Transports	0
				Conseil général des Alpes de Haute-Provence; Service de l'Environnement	0
				Conseil général des Alpes de Haute-Provence; Service Tourisme	0
				Agence de développement touristique des Alpes de Haute-Provence	0
FRdrome		NUTS3	Drôme	Département de la Drôme; Service de l'Aménagement du territoire	0
				Département de la Drôme; Service de l'Environnement	0
				Département de la Drôme; Service du tourisme	0
				Comité Départemental du Tourisme de la Drôme	1
FRha		NUTS3	Hautes-Alpes	Service des Politiques Territoriales	1
				Service de l'Eau et de l'Environnement	0
				Service du Développement du Tourisme	0
FRhsa		NUTS3	Haute-Savoie	Service de l'Aménagement	1
				Direction des Sports, du Tourisme et de la Politique Montagne	1
NA		NUTS3	Isére	Direction de l'Aménagement du territoire	0
				Direction de l'Aménagement du territoire; Service de l'Environnement	0
				Direction de l'Economie et du tourisme; Service du tourisme	0
				Comité Départemental du Tourisme de l'Isère	0
Frsa		NUTS3	Savoye	Direction de l'Environnement et du Paysage	1
				Direction des Politiques Territoriales; Services montagnes et tourisme	0
				Savoie Mont Blanc Tourisme	0
NA		NUTS3	Var	Conseil général du Var; Direction de l'Environnement	0
				Conseil général du Var; Direction du Développement économique et du Tourisme	0
NA		NUTS3	Vaucluse	Conseil général du Vaucluse; Direction Aménagement du Territoire, Logement, Foncier	0
				Conseil général du Vaucluse; Direction de l'Environnement	0
				Le Comité Départemental du Tourisme de Vaucluse	0
	Monaco				
MOges	Monaco	NUTS1/NUTS2/NUTS3	Monaco	Direction de l'Aménagement Urbain	*
				Direction de l'Environnement	*
				Département des Finances et de l'Economie; Direction du Tourisme et des Congrès	*
				not identified answer	1
	Italy				
Iges	Italy			Direzione generale per la tutela del territorio e delle risorse idriche	0
				ENEA (Agenzia nazionale per le nuove tecnolgie, l'ernergia e lo sviluppo economico sostenibile	0
				ENIT (Italian Government Tourist Board)	1
NA		NUTS2	Friulia Venezia Giulia	Servizio pianificazione territoriale regionale	0
				Servizio sviluppo sistema turistico regionale	0
				Agenzia Turismo Friuli Venezia Giulia	0
Ili		NUTS2	Liguria	Dipartimento Pianificazione territoriale, Urbanistica, Infrastrutture e Logistica	0
				Dipartimento Ambiente	0
				Dipartimento Agricoltura, Protezione Civile e Turismo	1
				Regione Liguria - informazioni turistiche	1
Ilo		NUTS2	Lombardi	Direzione Generale Territorio e Urbanistica	1
				Direzione Ambiente, Energia e Reti	0
				Direzione Commercio, Turismo e Servizi	0
				Portale del turismo Regione Lombardia	0
Ipie		NUTS2	Piedmont	Direzione Ambiente	1
				Pianificazione territoriale e paesaggistica	1
				Servizio a cura della Direzione Opere pubbliche, Difesa del suolo, Economia montana	1
				Direzione Turismo	0
				Sviluppo Piemonte Turismo	1
Itr		NUTS2	Trentino Alto Adige	Servizio Urbanistica e Tutela del Paesaggio, Trento	0
				Agenzia provinciale per la protezione dell'ambiente, Trento	0
				Servizio Turismo, Trento	0
				Trentino S.p.A Marketing AG	0
				Ufficio Coordinamento territoriale, Bolzano	0
				Agenzia provinciale per l'ambiente, Bolzano	0
				Ufficio Turismo e alpinismo, Bolzano	1
Iao		NUTS2	Aosta	Département duTerritoire et de l'Environnement; Direzione Urbanistica	*
				Département duTerritoire et de l'Environnement; Direction de l'Environnement	*
				Département du Tourisme, des Sports et du Commerce	1
				Ufficio Regionale del Turismo	*
				not identified answer	1
Ive		NUTS2	Veneto	Direzione Pianificazione Territoriale e Parchi	0
				Direzione Tutela Ambiente	0
				Direzione Turismo	1
	Slovenia				
SIges		NUTS1/NUTS2	Slovenia	Environment Directorate	1
				Environmental Agency of the RS	1
				Government office of the RS of Climate Change	1
				Tourism Directorate	1
				Slovenian Tourism Board	1
Sum of participants					94

* due to de-personalization the answers cannot be related to the organisation. The number of answers is listed without assignement.

Table 7: List of regions and participants (part 2)

D Documentation of calculation and aggregation of adaptive capacity indicators

D1 Set of specific adaptive capacity indicators for Alpine tourism

Determinant	**AC1 Knowledge and awareness**
Indicator	**AC1.1 problem awareness, attitudes towards climate change**
Hypothesis	Regions with a high problem awareness concerning climate change impacts in their own region have a higher adaptive capacity.
Research question	How relevant are climate change impacts for the tourism sector in the region?
Survey question	Aa1: In your opinion, how relevant are the impacts of climate change on the Alpine space? * Aa2: In your opinion, how important are the impacts of climate change on your region? * Aa3 We are interested in your opinion. Please indicate to what extent you agree with the following statements. Aa3 1: The impacts of climate change are already today causing global problems. * Aa3 2: The impacts of climate change will in future lead to global problems.* Aa3 3: The impacts of climate change are already today causing problems in our region.* Aa3 4: The impacts of climate change will in future lead to problems in our region. * Bb1 1: The impacts of climate change will in future not lead to problems in tourism in our region. * Bb1 2The impacts of climate change will in future lead to problems in tourism in our region. * Bb1 3: The impacts of climate change will lead in future to problems in winter tourism in our region. * Bb1 4: The impacts of climate change will in future lead to problems in summer tourism in our region. * Bb1 5: It would be sensible to already today realize measures to prevent negative consequences of climate change for tourism in our region.*
Calculation	Aa1: relevance of climate change impacts in Alpine space Sum of scores per expert/ number of answers x highest possible score Aa2: relevance of climate change impacts in region Sum of scores per expert/ number of answers x highest possible score A3: impacts on global and regional scale Global: 3a=3.1+3.2 Sum of scores per expert/ number of answers x highest possible score Regional: 3b=3.3+.3.4 Sum of scores per expert/ number of answers x highest possible score B1: climate change impacts on tourism in region Weighting: b1.1*0.5, b1.2*1, b1.3*1, b1.4*0.5, b1.5*1
Aggregation	Weighting: regional x 1, global x 0.5 AC1.1=0.5*scoreA1+0.5*score3a(global)+scoreA2+score3b+scoreB1(regional)/5
Indicator	**AC1.2 Access to information**
Hypothesis	Regions where Information about climate change impacts is available, have a higher adaptive capacity.
Research question	Do the stakeholders have access to information? Do they consider the information as sufficient to realize activities to adapt to climate change?
Survey question	Cc1: From which sources do you get information about climate change and possible adaptation strategies and activities?
Calculation	Cc1: available sources of information Weighting: Cc1.1=1, Cc1.2=1, Cc1.3=1, Cc1.4=2, Cc1.5=2, Cc1.6=2,

	Cc1.7=3, Cc1.8=3, Cc1.9=3, Cc1.10=2, Cc1.11=2, Cc1.12=2, comments=2,
Indicator	**AC1.3 Knowledge gaps/missing information**
Hypothesis	Regions where an awareness of knowledge gaps exists, have a higher adaptive capacity.
Research question	Are there any knowledge gaps from the actors' point of view? What are these gaps?
Survey question	Cc2: Is the available information about the impacts of climate change on your region sufficient to realize activities to adapt to climate change? Cc3: Which information is missing to realize activities to adapt to climate change?
Calculation	Cc2: sufficiency of information to realize adaptation action Sum of scores per expert/ number of answers x highest possible score Cc3: missing information Sum of scores per expert/ number of answers x highest number of scores (0,1)
Aggregation	AC1.3=(Cc2+Cc3)/2
Indicator	**AC1.4 Demand for further education/professional training**
Hypothesis	Demand for further education/professional training about possible courses of action concerning adaptation to climate change is a first step for adaptation activities.
Research question	Do the actors identify a demand for further education/professional training? In which fields?
Survey question	Cc4: On what issues would professional training in the field of "climate change adaptation and tourisms" be necessary?
Calculation	Comments=1, no comments=0; sum of scores per expert/ number of answers x highest number of scores (0,1)
Aggregation	**Equal weighting: AC1=(AC1.1+AC1.2+AC1.3+AC1.4)/4**

Determinant	**AC 2 (touristic) infrastructure**
Indicator	**AC2.1 natural assets/attractiveness of natural environment**
Hypothesis	Regions with a significant proportion of natural assets, have the potential for (summer) tourism.
Research question	How attractive is the region measured by the proportion of natural assets?
Survey question	E4a: How do you rate the attractiveness of the natural environment of your region for tourism?
Calculation	E4a: Sum of scores per expert/ number of answers x highest possible score
Indicator	**AC2.2 cultural assets/attractiveness of cultural heritage**
Hypothesis	Regions with a significant proportion of cultural assets, have the potential for (summer) tourism.
Research question	How attractive is the region measured by the proportion of cultural assets?
Survey question	E4b: How do you rate the attractiveness of the cultural heritage of your region for tourism?
Calculation	E4b: Sum of scores per expert/ number of answers x highest possible score
Aggregation	**Equal weighting: (AC 2.1 + AC2.2)/2**

Determinant	**AC3 Technology**
Indicator	**AC 3.1 Capacity for research and development**
Hypothesis	Regions having the possibility to invest in R&D/Regions that invest in R&D have a higher adaptive capacity.
Research question	Is research (in the field of climate change adaptation and tourism) conducted in the region?
Survey question	Bb3: A set of activities to adapt the tourism sector to the impact of climate change is being discussed. Please select from the following list those adaptation activities that were implemented in the past or are

	currently being implemented. Bb3 70: Promoting research and development projects in order to actively participate in climate change adaptation of tourism
Calculation	Bb370: mentioned=10, not mentioned =0

Determinant	**AC4 Institutions**
Indicator	**AC4.1 Structure of tourism sector**
Hypothesis	Tourism organisations divided into few big sections have a higher adaptive capacity than tourism organisation divided into small sections.
Research question	How is the tourism sector structured?
Survey question	Ee1: How is the tourism sector structured in your region? Ee5: Have any tourism organisations merged in your region in the last 20 years?
Calculation	Ee1: structure of tourism Weighting: Ee1.1=1, Ee1.2=-1, Ee1.3=1, Ee1.4=-1, Ee1.5=1, Ee1.6=0, Ee1.7=0, comments not included, Ee5: Merges of tourism organisations Sum of scores per expert/ number of answers x highest number of scores
Indicator	**AC4.2 Regional cooperation**
Hypothesis	Tourism organisations that have cooperation with local/regional/national authorities have a higher adaptive capacity than tourism organisation divided into small sections.
Research question	How does the cooperation between the tourism organisations, the authorities (e.g. spatial planning, environmental and economic agencies) and the local economies look like?
Survey question	Ee6: How intensive is the cooperation between tourism organisation, the authorities (e.g. spatial planning, environmental and economic agencies) and the local economies?
Calculation	Ee6: Intensity of cooperation between tourism sector and public authorities Sum of scores per expert/ number of answers x highest number of scores (0,1)
Aggregation	**Equal weighting: (Ee1 + Ee5+Ee6)/3**

Determinant	**AC5 Economic resources**
Indicator	**AC 5.1 Diversity of sector**
Hypothesis	Ee2a: The more diverse the tourism sector is, the higher is the adaptive capacity. Ee2b: If winter tourism is contributing to the added value of a region in a high extent, the adaptive capacity is diminished.
Research question	What is the diversity of the tourism sector in the region?
Survey question	Ee2a: What different forms of tourism are offered in your region? Ee2b: Please indicate the tourism forms that contribute most to the added value of your region.
Calculation	Ee2a: every choice = 1; max. number 11; no weighting between choices Ee2b: if winter sports under first three entries = 0; if winter sports not chosen =1 Aggregation: equal weighting (Ee2a + Ee2b)/2
Indicator	**AC 5.2 Capacity for innovation**
Hypothesis	The more innovative the tourism offers are, the higher is the adaptive capacity. Innovation: new suppliers, products, markets and new combinations of existing providers/services and markets (e.g. new collaborations)
Research question	How innovative are the tourism offers perceived?
Survey question	E3a: How innovative are the tourism offers in your region? E3b: Please indicate some innovative tourism products from your

	region.
Calculation	Ee3a: Sum of scores per expert/ number of answers x highest possible score E3b: Not included (yet).
Aggregation AC5	**Equal weighting: (AC 5.1 + AC5.2)/2**

Aggregation AC1-AC5	**(AC1*30+AC2*5+AC3*5+AC4*30+AC5*30)/100**

	AO Adaptation Options
Indicator	**AO1 Adaptation options (realized)**
Hypothesis	Regions where adaptation activities are already implemented, have a higher adaptive capacity.
Research question	What activities have already been implemented? Are the adaptation activities considered as effective?
Survey question	Bb3: What activities have already been implemented in your region to adapt the tourism sector to the impacts of climate change? A set of activities to adapt the tourism sector to the impact of climate change is being discussed. Please select from the following list those adaptation activities that were implemented in the past or are currently being implemented. Bb4: Which of the activities that have been implemented in your region do you consider as most effective?
Calculation	Bb3: Weighting: Bb3.1=1, Bb3.2=-1, Bb3.3=1, Bb3.4=0, Bb3.5=0, Bb3.6=0, Bb3.7=1, Bb3.8=-1, Bb3.9=-1, Bb3.10=-1, Bb3.11=1, Bb3.12=1, Bb3.13=1, Bb3.14=1, Bb3.15=1, Bb3.16=1, Bb3.17=1, Bb3.18=1, Bb3.19=1, Bb3.20=1, each comment=1, Sum of scores per expert/ number of answers x highest number of scores Bb4: weighting as in Bb3, Sum of scores per expert/ number of answers x highest number of scores
Aggregation AO1	Equal weighting: AO1=(Bb3+Bb4)/2
Indicator	**AO2 Adaptation options (potential)**
Hypothesis	The more adaptation options exist in a region, the higher is the region's adaptive capacity to climate change. Regions which implement adaptation strategies, do not have a high adaptive capacity per se. Regions which implement long-term adaptation strategies, have a higher adaptive capacity than regions implementing short-term adaptation options.
Research question	Which adaptation activities are considered appropriate for future adaptation?
Survey question	Bb5: Which other adaptation activities or strategies do you think are feasible in the tourism sector of your region by 2020? Bb6: In your opinion, on which activities the tourism sector in your region should focus to adapt to climate change?
Calculation	Bb5: Weighting: Bb5.1=1, Bb5.2=-1, Bb5.3=1, Bb5.4=0, Bb5.5=0, Bb5.6=0, Bb5.7=1, Bb5.8=-1, Bb5.9=-1, Bb5.10=-1, Bb5.11=1, Bb5.12=1, Bb5.13=1, Bb5.14=1, Bb5.15=1, Bb5.16=1, Bb5.17=1, Bb5.18=1, Bb5.19=1, Bb5.20=1, each comment=1, Sum of scores per expert/ number of answers x highest number of scores Bb6: weighting as in Bb5, Sum of scores per expert/ number of answers x highest number of scores
Aggregation AO2	Equal weighting: AO2=(Bb5+Bb6)/2
Aggregation AO	AO1 und AO2: (AO1+AO2)/2

Control Question1	**Self-estimation of Adaptive capacity**
Hypothesis	The self-estimation of the adaptive capacity correlates with the aggregated indicator based assessment.

Research question	How do experts evaluate the adaptive capacity of the region?
Survey question	D1: How do you assess the capacity of tourism to adapt to climate change impacts in your region?
Calculation	D1: Sum of scores per expert/ number of answers x highest possible score
Control Question2	**Willingness to adapt**
Hypothesis	The higher the willingness to implement adaptation measures is in a region, the higher is the region's adaptive capacity.
Research question	What is the region's level of willingness to implement adaptation measures?
Survey question	Bb1.5: We are interested in your opinion. Please indicate to what extent you agree with the following statements. "It would be sensible to already today realise measures to prevent negative consequences of climate change for tourism in our region." D2: What additional activities should be realised to increase the adaptive capacity of tourism to the impacts of climate change in your region?
Calculation	Bb1.5: Average value per region Likert-scale from 0-4 Therefore not aggregated. Included in the interpretation D2: not included (yet)

D2 Aggregation of Determinants according to expert delphi

Dimension	Standard Deviation	Average	Final Value
Economic resources	8.12239702	20.84	**21**
Knowledge and awareness	8.50979827	23	**23**
Infrastructure	6.1784572	16.44	**16**
Institutions	7.75736209	16.48	**17**
Technology	8.13572369	23.24	**23**
Sum		100	100

E Results

E.1 Normal version

	Knowledge and awareness					Infrastructure			Technology	Institutions	Economic reources				Adaptation Options			Control Questions	
RegID	AC1.1	AC1.2	AC1.3	AC1.4	AC1_ges	AC2.1	AC2.2	AC 2_ges	AC 3.1	AC4_ges	AC 5.1	AC 5.2	AC 5_ges	AC_ges	AO1	AO2	AO_ges	1	2
Aburg	5.1	3.1	5.0	10.0	5.8	10.0	10.0	10.0	10.0	6.3	9.1	5.0	7.1	6.7	8.4	7.0	7.7	7.5	4
Ages	5.8	3.0	6.3	NA	NA	10.0	10.0	10.0	10.0	4.6	4.8	6.2	5.5	NA	5.6	7.0	6.3	6.2	5
Akae	5.3	1.8	6.3	5.0	4.6	10.0	6.2	8.1	10.0	6.9	3.1	6.2	4.7	5.7	7.9	6.7	7.3	6.2	4.5
Anoe	5.7	2.6	5.0	NA	NA	10.0	7.5	8.8	10.0	4.2	7.9	5.0	6.4	NA	5.9	6.9	6.4	8.8	5
Aooe	3.4	3.2	5.0	NA	NA	8.8	6.2	7.5	10.0	8.1	8.6	6.2	7.4	NA	8.6	9.0	8.8	8.8	4.5
Asalz	6.0	2.4	7.5	10.0	6.5	10.0	8.8	9.4	10.0	4.8	4.5	6.2	5.4	6.0	8.5	7.3	7.9	6.2	5
Astei	6.0	3.5	10.0	NA	NA	10.0	5.0	7.5	10.0	NA	1.8	2.5	2.2	NA	2.3	8.4	5.3	7.5	5
Atirol	5.7	2.3	7.5	10.0	6.4	5.0	7.5	6.3	10.0	7.9	3.2	2.5	2.9	6.0	7.7	8.7	8.2	7.5	5
CHbe	5.7	3.2	8.8	10.0	6.9	5.0	6.2	5.6	10.0	5.0	4.5	6.2	5.4	6.0	10.0	9.9	9.9	7.5	4
CHfr	5.1	0.8	NA	NA	NA	7.5	7.5	7.5	0.0	NA	2.3	2.5	2.4	NA	5.0	6.4	5.7	2.5	3
CHges	6.3	2.7	6.0	6.0	5.2	8.0	7.0	7.5	10.0	5.0	4.5	6.0	5.3	5.5	10.0	10.0	10.0	6.0	4
CHgr	6.1	2.3	7.5	3.3	4.8	6.7	6.7	6.7	10.0	6.1	3.6	4.2	3.9	5.3	8.8	9.6	9.2	5.0	4
CHost	4.3	1.9	5.9	5.6	4.4	9.4	8.3	8.9	0.0	6.0	3.5	6.4	4.9	5.1	6.5	7.0	6.7	5.3	3.56
CHti	3.8	1.9	6.7	NA	NA	9.2	6.7	8.0	10.0	6.5	8.6	4.2	6.4	NA	8.3	7.9	8.1	4.2	2
CHvd	6.0	2.7	3.8	2.5	3.7	7.5	6.9	7.2	10.0	4.2	4.2	4.4	4.3	4.5	9.2	9.2	9.2	6.2	4
CHvs	4.4	2.0	5.0	2.5	3.5	10.0	6.9	8.5	10.0	7.2	3.3	5.6	4.5	5.5	7.6	7.5	7.5	8.1	3.5
CHzch	6.0	1.8	6.0	2.7	4.1	7.3	5.2	6.3	0.0	4.8	3.3	3.9	3.6	4.1	7.2	8.0	7.6	5.9	4.09
DEbay	5.2	1.9	3.5	2.0	3.1	4.0	4.0	4.0	10.0	3.4	9.3	2.5	5.9	4.4	7.5	6.6	7.1	4.0	4.2
DEges	4.7	3.5	NA	10.0	NA	10.0	5.0	7.5	10.0	NA	4.1	7.5	5.8	NA	7.7	8.4	8.0	7.5	4
FRam	5.5	2.7	10.0	10.0	7.1	10.0	10.0	10.0	0.0	7.1	8.2	5.0	6.6	6.7	5.4	8.0	6.7	5.0	5
FRdrome	4.7	1.2	NA	NA	NA	10.0	7.5	8.8	0.0	NA	7.8	5.0	6.4	NA	5.7	6.0	5.8	5.0	1
FRges	6.5	2.8	6.3	10.0	6.4	10.0	8.8	9.4	10.0	NA	4.8	6.2	5.5	NA	8.5	8.7	8.6	5.0	5
FRha	4.7	1.9	10.0	10.0	6.7	10.0	7.5	8.8	0.0	6.3	3.2	7.5	5.4	5.9	4.7	7.4	6.0	7.5	5
FRhsa	5.5	3.2	8.8	NA	NA	10.0	7.5	8.8	10.0	6.1	4.1	6.2	5.1	NA	5.0	5.5	5.2	6.2	4.5
Frsa	3.5	1.9	5.0	10.0	5.1	10.0	5.0	7.5	10.0	7.5	4.6	7.5	6.0	6.5	4.7	7.0	5.8	2.5	4
Iao	4.6	3.8	3.8	NA	NA	NA	NA	NA	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	2
Iges	5.9	0.8	NA	NA	NA	10.0	NA	NA	0.0	6.2	2.3	7.5	4.9	NA	6.4	6.7	6.5	7.5	5
Ili	4.0	1.6	2.5	5.0	3.3	5.0	3.8	4.4	0.0	1.7	8.7	1.2	4.9	3.2	6.7	NA	NA	1.2	1.5
Ilo	0.7	4.2	5.0	NA	NA	7.5	7.5	7.5	0.0	NA	4.6	7.5	6.0	NA	7.0	3.0	5.0	2.5	1
Int	5.0	2.8	4.2	3.3	3.8	5.8	5.8	5.8	10.0	4.2	2.6	3.3	3.0	4.1	6.1	6.2	6.1	6.7	3.67
Ipie	5.2	1.5	6.9	7.5	5.3	9.4	9.4	9.4	10.0	4.2	3.1	5.0	4.0	5.0	5.6	9.1	7.4	4.4	3.25
Itr	5.5	4.2	10.0	10.0	7.4	10.0	10.0	10.0	10.0	7.5	2.8	5.0	3.9	6.6	7.4	8.4	7.9	7.5	5
Ive	5.4	1.2	5.0	10.0	5.4	10.0	10.0	10.0	0.0	6.7	3.7	2.5	3.1	5.0	7.0	6.7	6.8	2.5	5
LIges	5.6	2.1	5.6	2.5	4.0	7.5	6.9	7.2	0.0	2.9	2.4	3.1	2.8	3.3	6.5	7.0	6.7	6.9	3.75
MOges	4.2	1.5	NA	NA	NA	10.0	10.0	10.0	0.0	4.2	7.8	7.5	7.6	NA	6.4	6.0	6.2	10.0	4
SIges	6.7	2.5	7.0	8.0	6.0	9.5	7.5	8.5	10.0	5.2	4.5	4.5	4.5	5.6	8.6	8.2	8.4	5.5	4.4

E.2 Benchmark version

	Knowledge and awareness					Infrastructure			Technology	Institutions	Economic reources				Adaptation Options			Control Questions	
RegID	AC1.1	AC1.2	AC1.3	AC1.4	AC1_ges	AC2.1	AC2.2	AC 2_ges	AC 3.1	AC4_ges	AC 5.1	AC 5.2	AC 5_ges	AC_ges	AO1	AO2	AO_ges	1	2
Aburg	5.0	6.8	5.0	10.0	6.7	10.0	10.0	10.0	10.0	5.9	8.9	6.0	7.5	7.0	8.1	6.2	7.2	7.2	7.5
Ages	5.7	6.5	5.4	NA	NA	10.0	10.0	10.0	10.0	4.2	5.0	7.9	6.5	NA	4.1	5.7	4.9	5.7	10
Akae	5.1	2.9	5.4	3.8	4.3	10.0	3.9	6.9	10.0	6.6	2.2	7.9	5.1	5.7	7.0	5.3	6.2	5.7	8.75
Anoe	5.7	5.3	4.2	NA	NA	10.0	6.0	8.0	10.0	3.7	6.8	6.0	6.4	NA	4.9	6.1	5.5	8.6	10
Aooe	3.1	7.1	4.2	NA	NA	8.0	3.9	5.9	10.0	8.3	8.0	7.9	8.0	NA	8.4	8.6	8.5	8.6	8.75
Asalz	6.0	4.7	7.5	10.0	7.1	10.0	8.1	9.0	10.0	4.4	4.6	7.9	6.3	6.3	7.9	6.1	7.0	5.7	10
Astei	5.9	7.9	10.0	NA	NA	10.0	1.9	6.0	10.0	NA	0.0	2.1	1.0	NA	0.0	7.9	3.9	7.2	10
Atirol	5.7	4.4	7.5	10.0	6.9	1.7	6.0	3.8	10.0	7.8	2.4	2.1	2.2	5.8	7.3	8.2	7.8	7.2	10
CHbe	5.6	7.1	8.8	10.0	7.8	1.7	3.9	2.8	10.0	4.4	4.6	7.9	6.3	6.2	10.0	9.7	9.8	7.2	7.5
CHfr	4.9	0.0	NA	NA	NA	5.8	6.0	5.9	0.0	NA	0.8	2.1	1.4	NA	3.7	5.4	4.6	1.5	5
CHges	6.2	5.6	5.0	5.0	5.4	6.7	5.2	5.9	10.0	4.6	4.6	7.6	6.1	5.6	10.0	9.9	9.9	5.5	7.5
CHgr	6.1	4.4	7.0	1.6	4.8	4.5	4.7	4.6	10.0	5.8	3.0	4.8	3.9	5.1	8.4	9.2	8.8	4.3	7.5
CHost	4.1	3.2	5.1	4.5	4.2	9.0	7.3	8.1	0.0	5.7	2.8	8.3	5.5	5.0	5.4	5.9	5.7	4.7	6.4
CHti	3.4	3.2	6.2	NA	NA	8.7	4.7	6.7	10.0	6.5	8.0	4.8	6.4	NA	8.0	7.3	7.7	3.4	2.5
CHvd	5.9	5.6	2.9	0.6	3.8	5.8	5.0	5.4	10.0	3.7	4.1	5.1	4.6	4.4	9.1	8.9	9.0	5.7	7.5
CHvs	4.1	3.5	3.8	0.6	3.0	10.0	5.0	7.5	10.0	7.1	2.5	7.0	4.8	5.3	6.6	6.2	6.4	7.8	6.25
CHzch	6.0	2.9	5.4	0.9	3.8	5.5	2.3	3.9	0.0	4.2	2.5	4.3	3.4	3.6	6.4	7.2	6.8	5.3	7.72
DEbay	5.1	3.2	2.5	0.0	2.7	0.0	0.3	0.2	10.0	2.8	9.2	2.1	5.6	3.8	6.8	5.5	6.2	3.2	8
DEges	4.6	7.9	NA	10.0	NA	10.0	1.9	6.0	10.0	NA	3.9	10.0	7.0	NA	7.3	7.9	7.6	7.2	7.5
FRam	5.4	5.6	10.0	10.0	7.7	10.0	10.0	10.0	0.0	6.8	7.4	6.0	6.7	6.9	4.1	7.4	5.8	4.3	10
FRdrome	4.4	1.2	NA	NA	NA	10.0	6.0	8.0	0.0	NA	6.6	6.0	6.3	NA	5.0	5.0	5.0	4.3	0
FRges	6.5	5.9	6.3	10.0	7.1	10.0	8.1	9.0	10.0	NA	5.0	7.9	6.5	NA	7.9	8.0	8.0	4.3	10
FRha	4.5	3.2	10.0	10.0	6.9	10.0	6.0	8.0	0.0	5.9	2.4	10.0	6.2	6.1	3.3	6.6	5.0	7.2	10
FRhsa	5.4	7.1	8.8	NA	NA	10.0	6.0	8.0	10.0	5.6	3.8	7.9	5.9	NA	3.0	4.2	3.6	5.7	8.75
Frsa	3.2	3.2	5.0	10.0	5.4	10.0	1.9	6.0	10.0	7.6	4.7	10.0	7.3	6.9	2.7	5.8	4.2	1.5	7.5
Iao	4.4	8.8	2.9	NA	NA	NA	NA	NA	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.5
Iges	5.8	0.0	NA	NA	NA	10.0	NA	NA	0.0	6.0	0.8	10.0	5.4	NA	5.8	5.8	5.8	7.2	10
Ili	3.6	2.4	1.7	3.8	2.9	1.7	0.0	0.8	0.0	0.9	8.1	0.0	4.1	2.4	5.0	NA	NA	0.0	1.25
Ilo	0.0	10.0	5.0	NA	NA	5.8	6.0	5.9	0.0	NA	4.7	10.0	7.3	NA	6.6	0.4	3.5	1.5	0
Int	4.8	5.9	3.0	1.6	3.8	3.0	3.2	3.1	10.0	3.8	1.4	3.3	2.3	3.6	5.0	4.9	4.9	6.3	6.67
Ipie	5.1	2.1	6.4	6.9	5.1	9.0	9.0	9.0	10.0	3.7	2.1	6.0	4.1	4.8	4.0	8.8	6.4	3.6	5.62
Itr	5.4	10.0	10.0	10.0	8.9	10.0	10.0	10.0	10.0	7.5	1.6	6.0	3.8	7.0	7.0	7.4	7.2	7.2	10
Ive	5.3	1.2	5.0	10.0	5.4	10.0	10.0	10.0	0.0	6.7	3.1	2.1	2.6	4.9	6.6	5.8	6.2	1.5	10
LIges	5.5	3.8	4.8	0.6	3.7	5.8	5.0	5.4	0.0	2.6	1.0	3.0	2.0	2.7	5.4	6.1	5.7	6.5	6.88
MOges	3.8	2.1	NA	NA	NA	10.0	10.0	10.0	0.0	4.1	6.6	10.0	8.3	NA	5.8	5.0	5.4	10.0	7.5
SIges	6.7	5.0	7.0	7.5	6.5	9.2	6.0	7.6	10.0	4.7	4.6	5.2	4.9	5.7	8.3	7.6	7.9	4.9	8.5

F Overview of sectors addressed by the Action Plan on Climate Change in the Alps

Sectors	Goals and strategies
Tourism	• Reduce CO_2 emissions produced by tourist activities and ensure travel professionals offer the option of sustainable transport • Promote Alpine holidays offers that are "climate neutral" • Adapt winter tourism and diversify the tourism offer
Spatial and land planning	• Ensure efficient space management, promote urban densification • Promote CO_2 efficient urbanisation and planning • Promote an integrated to adapt Alpine space to new climatic conditions and more particularly to: o Better control natural hazards and limit their consequences o Ensure sustainable development in terms and economic activities
Energy (esp. heating energy)	• Significantly reduce CO_2 emissions • Promote the use of renewable energy sources
Transport	• shift traffic towards more eco- and climate-friendly means of transportation • Significantly reduce CO_2 emissions linked to transport
Mountain forestry	• Favor the adaptation of forest stands to climate change by keeping the Alpine forests in a good ecological state and increasing their biodiversity • Develop forestry so that wood can be used as a material and as an energy source that would benefit the economic development of local populations • Reinforce the role played by the forests in preventing natural hazards
Mountain farming	• Support mountain farming as a contribution to the environment, the maintenance and the attractiveness of Alpine territories
Biodiversity	• Create an ecological continuum in order to facilitate the migration of Alpine fauna and flora species • Preserve the biodiversity of protected areas and maintain ecosystem services • Ensure habitat preservation for species that are representative of the Alps • Support quality agriculture which contributes to the protection of the environment and to the stability of biodiversity • Maintain peat lands as CO_2 sinks and biodiversity reservoirs
Water and water resources	• Reinforce the implementation of the Water Framework Directive • Prevent water shortage • Steer the development of hydropower plants according to the ecology of water systems
Applied research and awareness-raising	• Improve knowledge to better understand the impact of climate change on a local level, particularly as far as water, natural hazards and socio-economic balance are concerned • Reinforce cooperation in order to gain common knowledge of the existing risks • Reinforce public awareness, especially among the youth

Table 8: Overview of sectors addressed by the Action Plan on Climate Change in the Alps (Permanent Secretary of the Alpine Convention 2009)