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Mountain guides facing the effects of climate change. What perceptions and adaptation strategies at the foot of Mont Blanc?

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Introduction

- 1 The consequences of ongoing climate change are increasingly studied (Stocker *et al.*, 2013). The way it modifies the glaciological and geomorphological characteristics of high mountains environments is a crucial topic (Haeberli *et al.*, 2010; Einhorn *et al.*, 2015; Beniston *et al.*, 2018). However, while its impact on alpine skiing is well documented (Paccard, 2009; Joly and Ungureanu, 2018), its consequences on summer practises have been so far the subject of a more limited research. According to initial studies, high Alpine mountains seem to be more dangerous for mountaineering in general (Pröbstl-Haider *et al.*, 2016; Temme, 2015; Ritter *et al.*, 2012).
- 2 The issue of adaptation to the consequences of global warming is now a key issue in political discussions (Garcia, 2015) and is one of the two strategies advocated by the IPCC to address climate change (Simonet, 2015).

- 3 At the foot of Mont Blanc, the highest point in the Alps (4809 m a.s.l.), the historical and massive presence of Alpine guides in Chamonix and Courmayeur offers the opportunity to question a profession evolving at high altitude. The objective of this paper is to question the relationship between the profession of Alpine guides, its areas of practice (Mao, 2003) and climate change in order to reveal the adaptation strategies these professionals are developing.
- 4 High mountains environments are one of the most affected areas by warming temperatures (Haeberli *et al.*, 2010). In the French Alps, the annual average temperature has increased by +1.8°C to +2.1°C since 1950 (Einhorn *et al.*, 2015), while it is only 0.85°C at the global scale between 1880 and 2012 (Stocker *et al.*, 2013).
- 5 Since the end of the Little Ice Age (~1855), all Alpine glaciers are retreating (Zemp *et al.*, 2015); their surface has reduced by half between 1900 and 2012 (Huss, 2012), and the trend should lead to their near disappearance by 2100 (Zekollari *et al.*, 2019).
- 6 In high mountain areas, permafrost, *i.e.* permanently frozen soils/rock for at least two consecutive years, warms up quickly. Thermal models for several summits of the Mont Blanc massif, including the Aiguille du Midi (3842 m a.s.l.), show a significant degradation between 1850 and 2015 (Magnin *et al.*, 2017).
- 7 This permafrost warming leads to an increase in the frequency of slope instabilities such as rockfalls ($V > 100 \text{ m}^3$), with peaks observed during hot summers on the northern and southern slopes of the Mont Blanc Massif (Chiarle *et al.*, 2017; Ravelle *et al.*, 2017).

From environmental changes to changes for Alpine guide, an adaptation issue

- 8 The construction of the profession of Alpine guide is the result of many successive adaptations (Bourdeau, 1991) that today lead to the adaptation issue to climate-induced environmental changes. The latter can be defined as the adjustment of an individual or a group in response to climate stimuli and their effects (Swart and Raes, 2007). Adaptation is then a response to a problem (Godard, 2010) whose objective is to reduce the vulnerability of the individuals exposed to profound and rapid disturbances (Simonet, 2015). In the field of tourism, the issue of adaptation to climate change has developed rapidly since the 2000s (Kaján and Saarinen, 2013). For the authors, an individual's adaptive capacity consists of his efficiency in implementing mechanisms and strategies to survive in the face of a threat (Adger, 2000; Pielke, 1998). Although generally in the tourism and recreation sectors, adaptive capacity is considered strong (Scott *et al.*, 2009), it remains context-specific and varies from one group to another (Smit and Wandel, 2006).
- 9 This issue of climate change adaptation for mountain guides is not well documented in the literature. Bourdeau's report (2014) explores the evolution of the mountain guide profession in the Ecrins massif and shows the development of a "climate intelligence" aiming to maintain professional activity. Outside the Alps, studies are being carried out on the impact of glacial retreat on Norwegian guides who have an increased difficulty to access glaciers (Furunes and Mykletun, 2012). In New Zealand, guides offering glacier hikes are also facing this increased difficulty to access glaciers and together with an increased danger from rock falls (Purdie, 2013; Purdie *et al.*, 2015). As a result, mountain

guides have halved the period during which they climb Mount Cook (3724 m a.s.l.; Purdie and Kerr, 2018). The question of accessing glaciers is also raised around the Everest base camp (Watson and King, 2018) and also represents a particular challenge for access to the high mountain refuges of the Mont Blanc massif (Mourey and Ravel, 2017). Through their practice, mountain guides have "invented the itineraries" (de Bellefon, 1999), the very ones that constitute the main support of their activity and which are today impacted by climate change (Bourdeau, 2014; Purdie and Kerr, 2018). All these itineraries constitute the practice area (Mao, 2003) of mountain guides.

- 10 The geomorphological changes in high mountain areas linked to climate change require major changes in mountaineering routes and the conditions of their frequentation. In the Mont Blanc massif, 25 processes and phenomena related to climate change affect routes that tend to become more technically difficult and dangerous during the summer period (Mourey *et al.*, 2019). In this context, the objective of this article is:

Method

- 11 In order to clearly define the impact of the territorial context on changes in the profession of mountain guide, it is necessary to define what will be called: (i) the area of practice (Mao, 2003) in which most of the activity takes place, *i.e.* the high mountain areas with their mountaineering routes, and (ii) professional anchoring places, where the main guide offices and guides are based.
- 12 The Mont Blanc massif then represents an area of practice particularly adapted to our research. With its 165 km² of ice surface and its 24 prestigious peaks of more than 4000 m a.s.l (Mont Blanc; Aiguille Verte, 4122 m a.s.l; Grandes Jorasses, 4208 m a.s.l; etc.), it is an emblematic massif for mountaineering and its main birthplace (Debarbieux, 2012). There are two main "gates" that represent the two emitting territories: Chamonix for the north-western French side, supported by facilities such as the Aiguille du Midi cable-car (3777 m a.s.l), and Courmayeur for the south-eastern Italian side with the Skyway cable-car giving access to the pointe Helbronner (3462 m a.s.l.). In addition, these two issuing territories are the birthplace of the profession of guide with the creation of the first two guide companies of the world: Chamonix in 1821 and Courmayeur in 1850.
- 13 The method used on both sides of Mont Blanc consists in a quantitative survey supported by a series of semi-structured interviews.
- 14 The quantitative survey is composed of 50 questions (Appendix 1) and is structured as follows:
 - the general working habits of the mountain guides (7 questions);
 - a focus on their summer work habits (5 questions);
 - the difficulties induced by climate change and how guides adapt to them and perceive them (22 questions);
 - their socio-professional profile (6 questions).
- 15 Semi-structured interviews are developed as follows:
 - the professional background of the mountain guide;
 - the way he practises the profession;
 - climate change, subdivided into two sub-themes:

- the way in which climate change is constraining the practice of guiding;
 - how the guides adapt to these constraints;
 - the way in which constraints and adaptations are perceived.
- 16 On the French side, the quantitative survey was first sent by email in November 2017 to the 1332 active mountain guides, members of the 'Syndicat National des Guides de Haute Montagne' (SNGM), the national union of alpine guides. The response rate was 17 % (230 responses) after one month and two reminders. The survey was sent to the national population of guides but the socio-professional profile made it possible to isolate those working in the Chamonix valley: it was chosen for this study to keep only the responses of guides residing in the Chamonix-Mont-Blanc valley (Chamonix, Servoz and Vallorcine), thus excluding guides from Saint-Gervais-les-Bains, another "gateway" to the Mont Blanc massif which, by its history and the importance of its guides company (over 80 professionals), geographically constitutes another place of professional establishment. The one-hour-long (on average) semi-structured interviews were conducted in Chamonix with 11 Alpine guides chosen to represent a wide range of ages and experiences, as well as employment status (self-employed, employees, registered or not in a company), between March and April 2017.
- 17 For Courmayeur, the survey form was translated into Italian and sent to all guides in Valle d'Aosta (April-May 2018) with two reminders. The attachment company was used to create a stratum that included only guides from Courmayeur. It should be noted that unlike in France where guides are not necessarily attached to a company, 47 (94 %) of the 50 guides working in Courmayeur are members of the '*Société des Guides*' (data from '*Société des Guides de Courmayeur*') in the Valle d'Aosta. 14 of them replied (30 % of response rate). 8 semi-structured interviews were also conducted in April 2018, in French and during one hour in average, using the same selection criteria and structured in the same way as those conducted on the Chamonix side. Two members of the 'Fondation Montagne sûre' (including an aspirant-guide), bilingual Italian/French, attended all the interviews in order to avoid any possible language bias.
- 18 The quantitative data were analysed using the *Sphinx IQ²* software. As for the interviews, they were fully transcribed and qualitatively analysed using *MaxQDA* software.

Mountain guides facing climate change: impacts and adaptations

Remarkable impacts on mountaineering practice

- 19 All the guides who participated in the interviews or replied to the quantitative surveys in Chamonix or Courmayeur state that they observe changes in the high mountains in relation to climate change.
- 20 Glacial retreat is perceived as the most significant of these changes. In particular, it leads to the disappearance of the practice sites of "ice schools", i.e. the spaces supporting the activity of learning glacier techniques. This is particularly the case on the Chamonix side with the Bossons glacier. The increasing danger of the glacier due to its retreat prompted the guides to move the ice schools to the Mer de Glace from the early 1990s. However, the retreat of the glacier front, which was largely mentioned

during the interviews, is now questioning the profession about a new repositioning of the activity towards the Col des Grands Montets, located almost 1500 m higher in altitude (3233 m a.s.l.) and more quickly accessible thanks to a cable-car (Figure 1). On the Courmayeur side, the situation is similar with regard to the retreat of the Pré-de-Bard glacier. However, according to G. Signò, former director of the Société des Guides de Courmayeur, Courmayeur guides do not work much with "ice schools".

Figure 1: Displacement of the "ice school" practice area in the Chamonix valley

Realization E. Salim, J. Mourey, L. Ravanel et C. Gauchon, 2019.

- 21 Glacial retreat also causes difficulty in accessing some routes. Rocky routes such as the Rébuffat route at the Aiguille du Midi or the Grand Capucin (3838 m a.s.l.) are often mentioned by the guides on both sides. Glacial retreat has caused an additional 25-m-climb pitch since the late 1980s, changing the historical route (Mourey *et al.*, 2019).
- 22 The summer "drying up" of the mountain, *i.e.* the disappearance of ice/snow covers, is the second most frequent phenomenon mentioned during the interviews. It results in a growing number of itineraries that are not possible to climb in summer: Whympfer and Couturier couloirs at the Aiguille Verte, the normal route of the Tour Ronde (3792 m a.s.l.), etc. These classic itineraries are now unfrequented in the summer season according to many guides interviewed in Courmayeur and Chamonix.
- 23 The issue of dangerousness is also widely mentioned. Correlated to the summer heat waves, the increase in the frequency of rock destabilizations restricts access to certain areas. For E. Ratouis or F. Chapon from Chamonix valley, the Aiguilles de Chamonix area is subjected to more and more frequent rock falls. For O. Taiola (guide and mountain rescue manager in Valle d'Aosta from 1985 to 2015), there is an increase in accidents related to rock falls during hot periods.
- 24 Climate change also impacts the guides' winter season, mainly by reducing the duration of the snow cover. The interviewed guides from Courmayeur and Chamonix, all practising the ski descent of the famous Vallée Blanche in winter, mentioned the difficulties linked to the often early snow removal of the lower part of the slope.

Development of adaptation strategies

- 25 During the interviews, all the French and Italian guides said they are changing the way they work in order to adapt to the effects of climate change in three main ways (Figure 2).
- 26 In Chamonix and Courmayeur, the first strategy mentioned is the change of the type of route used when conditions for mountaineering are bad. 6 of the 8 guides interviewed in Courmayeur cite the normal route of the Tour Ronde as an example. Since conditions are very often bad in summer, the guides generally chose to climb the southeast ridge, a rocky route less subject to random conditions. In Chamonix, poor conditions on busy glacial routes such as the Petite Aiguille Verte (3512 m a.s.l.) push the guides to choose a rocky objective, often in the Aiguilles de Chamonix or in the Aiguilles Rouges massif, further down in altitude. In addition, many Chamonix and Courmayeur guides claim to regularly take their clients to more remote mountain ranges such as Grand Paradiso, Valais or Les Écrins, which allows them to increase the possibilities of having good conditions. All these practices reveal a form of 'omni-mobility', a strategy that makes it possible to partly avoid local constraints linked to climate change.
- 27 In Chamonix, many guides like Y. Delevaux (*Compagnie des Guides de Chamonix* Director in 2017) deal with the need to be more flexible towards customers. For M. Bordet (president of the Chamonix Independent Guides), this flexibility is combined with a desegmentation of the practice time frames. It is thus becoming more and more classic to practice "summer" mountaineering in December, the main issue being to convince customers for Y. Delevaux. This adaptation reflects the need for 'omni-reactivity' towards conditions and customers.
- 28 A form of diversification of activities also seems to be emerging. In order to avoid the effects of climate change, French guides such as F. Bernard or E. Ratouis say they are supervising more and more activities that are not practiced in high mountains such as climbing schools, mountain biking, trail or *via ferrata*. Finally, many French guides such as M. Bordet, F. Bernard, F. Chapon or Italian guides such as A. or O. Clavel mentioned a postponement of the practice of the profession to winter and in particular to off-piste skiing, which, in addition to meet customer demands, allows them to overcome conditions they consider "hazardous" in summer.

Figure 2: Diagram summarizing the different impacts related to climate change and the adaptation strategies adopted

Realization E. Salim, J. Mourey, L. Ravel et C. Gauchon, 2019.

Impacts, adaptations and perceptions influenced by the place of professional attachment

The same practice area

- 29 Chamonix and Courmayeur guides come from two different emitting territories but they work in the same practice area, the Mont Blanc massif, and the routes they frequent are often the same: Tour Ronde (normal route or north face), Mont Blanc (*via* Le Goûter or the "Trois Monts") and Mont Blanc du Tacul (4248 m a.s.l.). The great mixed routes such as the Grand Jorasses, the Rochefort ridge or the Mont Blanc *via* the Innominata Ridge or the Brenva are also mentioned by the guides on both sides. Nevertheless, some major Chamonix routes such as the Whymper and Couturier couloir on the Aiguille Verte or the couloirs of the Argentièr glacier basin are not mentioned by Courmayeur's guides.
- 30 For rocky routes, Courmayeur's guides do not mention the itineraries of the Aiguilles de Chamonix, while the Dent du Géant (4013 m a.s.l.) is little taken as an example during the interviews in Chamonix. However, other high places of climbing such as the Grand Capucin (3838 m a.s.l.) are mentioned by both groups of guides.
- 31 For the winter period, few specific itineraries are mentioned, except for the descent of the Vallée Blanche, which is the main off-piste skiing itinerary for guides in both sectors. Chamonix guides are accessing it *via* the Aiguille du Midi cable-car while Courmayeur guides set foot on the glacier *via* the Skyway, with Chamonix-Courmayeur shuttles planned for the return trip. Concerning ski touring, the few major routes mentioned are the same from one side to the other of the Mont Blanc: 'Haute Route'

between Chamonix and Zermatt, Mont Blanc by skis through the Grands Mulets refuge, etc.

A different perception of the impacts of climate change

- 32 While guides on both sides are unanimous in observing the evolution of high mountains facing climate change, their perception of the seasonal shift in periods of good conditions for the practice diverges. In Chamonix, the season is perceived as shifting towards spring and autumn by about 4 weeks, which confirms Bourdeau's (2014) results for the Écrins massif. In Courmayeur, only the month of August is perceived as very bad in terms of mountaineering conditions and the guides interviewed do not perceive an extension of the practice season.
- 33 According to the interviews conducted, this difference in the perception of climate change impacts is mainly related to the guides-customer's relationship. During the interviews, the Courmayeur guides asserted on the very close relationship they have with their clients, most of which are regular. In Chamonix, while they also have a close relationship with some clients, a larger part of the guides say they work regularly with a "one-day" customer. This distinction is also shown by the level of difficulty of the routes achieved by the two populations of guides. Indeed, on the Chamonix side, guides mainly climb Easy or Not Very Difficult routes (56 %) while in Courmayeur only 28 % of the itineraries climbed are of this level. On the other hand, 36 % of the routes climbed by Courmayeur guides are Difficult (D) or Very Difficult (TD) compared to only 17 % in Chamonix, which supports the idea of a more regular customer in Courmayeur. Courmayeur guides refer to their close relationship with their clients by stating that it is easy for them to change the planned itinerary at the last minute depending on the conditions. At the same time, the Chamonix guides explain that it is difficult to convince the "one-day" customers to change their itineraries if the conditions are bad. This may explain why Courmayeur guides do not perceive any extension of the season since they can organize their summer by easily adapting their itineraries to the conditions.

Different adaptation strategies for the same constraint

- 34 A comparison of the adaptation strategies developed in the two territories reveals differences. In Courmayeur, the omni-reactivity strategy was rarely mentioned during the interviews. The competition between guides in the two territories could be an explanation with, in the summer season, more than 400 guides in Chamonix compared to 50 in Courmayeur. In addition, 13 structures sell mountaineering activities in Chamonix when there is only the *Société des Guides* in Courmayeur. According to G. Signò, this configuration can lead Chamonix guides to feel forced to accept a course where the route is in poor condition by fear that their potential customer would find a guide in another structure. Conversely, this consideration is not taken into account by Courmayeur guides who do not hesitate to change their itinerary knowing that no other structure will be able to respond favourably to the client.
- 35 This is also visible in the way guides represent their customers: only 14 % of the Courmayeur guides believe that their customers are not willing to change their

objectives according to the constraints linked to climate change, compared to 33 % in Chamonix.

- 36 Another divergence in adaptation strategies is that multi-activity is less present in Courmayeur than in Chamonix. This difference seems to be once again related to the type of customer. More oriented towards multi-outdoor sport in Chamonix (mountaineering activities never represent more than 20 % of the structures' revenues), the customer is considered as more "traditional" in Courmayeur. G. Signò states that "mountaineering is the main activity for the *Société des Guides* in summer".
- 37 Chamonix guides, such as E. Ratouis, F. Bernard or J.-P. Lacoste (Director of the UCPA Chamonix), turn to activities such as mountain biking, trail or *via ferrata* in order to avoid the dangers too high in high mountain areas linked, in particular, to the degradation of permafrost. However, the evolution of the sport identity of Chamonix, particularly through events such as the Ultra-Trail-du-Mont-Blanc (Bessy, 2016), can be an explanatory factor of the evolution of the customer. In addition, the trend towards diversification of mountain sports tourism activities is visible in other territories (Savelli, 2012; Perrin-Malterre, 2016). In this way, the phenomenon of the shift from mountaineering activities to multisport outdoor perceived as a strategy of adaptation to climate change by the Chamonix guides would also be an adjustment of their practice in response to changes in tourism, which would be experienced as an opportunity to free themselves from the constraints linked to climate change.
- 38 These differences between territories can therefore be explained by their singular tourist flows. The Chamonix valley has 4,700,000 annual overnight stays, 55 % of which are distributed in winter and made up of mainly foreign tourists (57 %; Chamonix Tourism Office data, 2017). In Courmayeur, the total number of annual nights is 1,001,343, 53 % of which are spent in winter and are mainly related to Italian tourists (58 %; TourismOK data, 2018). According to N. Durochat (Director of Chamonix' TO), tourists in Chamonix are attracted by the "mountain" image, but do not practice it. The communication of the tourism office then concerns all mountain sports that are practiced by tourists for entertainment purposes. On the other hand, Courmayeur's tourist customer is more motivated by "nature", well-being and resting (TourismOK data, 2016).

An adaptation perceived as easier in Courmayeur than in Chamonix

- 39 Concerning the perception of adaptation, the quantitative surveys show that, on a scale of 1 (very easy adaptation) to 10 (very difficult adaptation), the average response for Courmayeur is 3.46 with a maximum of 5/10 compared to an average of 5.38 with a maximum of 9/10 in Chamonix. This result is confirmed by the interviews where guides from Chamonix are much more worried than guides from Courmayeur.
- 40 This difference can once again be explained by a less flexible customer in Chamonix than in Courmayeur, the statistical relationship between the perceived difficulty of adaptation and the question "Is your customer ready to adapt their high mountain practice to the changing environments?" for Chamonix guides is "not significant" ($p = 0.18$; $\chi^2 = 11.34$). However, by extending the sample to all French guides, the relationship becomes "very significant" ($p = <0.01$; $\chi^2 = 28.73$). The flexibility of the customer therefore seems to be an important element in the perception of the difficulty in adapting.

- 41 The imaginary of the guides also seems different between the two sides of the Mont Blanc: to the question "Is the transformation of the landscapes shifting your imaginary of the high mountains?", 54 % of Chamonix guides answered "yes" against only 7 % in Courmayeur. This difference is difficult to analyse since the question of the imagination was not explored in the interviews. However, it can be hypothesized that it would be related to the fact that Courmayeur guides indicate working more than Chamonix guides on conventional routes at altitudes above 4,000 m where the impacts of climate change are less rapid (Einhorn *et al.*, 2015). Indeed, the cross sorting between the difficulty of adaptation and the discrepancy of the imagination among French guides shows a "very significant" relationship ($p = 0.003$; $\text{Khi}^2 = 24.71$).
- 42 Some limits can be mentioned with regard to these results. First of all, the number of guides interviewed is satisfactory in Courmayeur (8/50) but it is questionable in Chamonix (11/400). However, a saturation of the sample is quickly observed: new information is limited from the 4th interview. Secondly, the number of responses to the quantitative survey, while allowing statistical analysis (Ganassali, 2014), remains low to be fully satisfactory. However, the methodological approach of combining quantitative and qualitative data makes it possible to cross-check the results: they show here how the dynamics, particularly tourism, of the place of professional attachment influence adaptation strategies and the perception that professionals have of them (Figure 3). As research in this field is recent, it would seem interesting to pursue further investigations, particularly with regard to the evolution of the customer or the relationship with professional culture (Corneloup and Bourdeau, 2002) and the place of the profession of guide among professionals in outdoor sports.

Figure 3: Synthesis of factors influencing adaptation to the effects of climate change among mountain guides

Realization E. Salim, J. Mourey, L. Ravanel et C. Gauchon, 2019.

Conclusion

- 43 Changing high mountain environments caused by climate change - generalized degradation of the cryosphere and associated processes - act as an adaptive injunction for mountain guides. The responses to these changes are varied: the emergence of a form of omni-reactivity and omni-mobility, the transfer of part of the activity to the

winter period or the diversification of supervised activities are adaptation strategies that help to increase the resilience of mountain guides.

- 44 However, although the Courmayeur and Chamonix guides have the same effective practice area, their perception of the constraints and the adaptation strategies they implement to face climate change are different. Courmayeur guides have developed a less omni-reactivity, while Chamonix guides seem to be turning more and more towards a diversification of their activities.
- 45 Adaptation to climate change is also perceived in different ways by different groups of guides. In Courmayeur, guides consider adaptation to be easier than in Chamonix. These differences in perception are controlled on the one hand by the customer-guide relationship and a customer perceived as more flexible in Courmayeur and, on the other hand, by the imagination of the high mountain guide: a greater gap between reality and imagination seems to exist in Chamonix, contributing to an adaptation perceived as more difficult.

BIBLIOGRAPHY

Adger W. N., 2000.- "Social and ecological resilience : are they related ?" *Progress in Human Geography* 24(3) pp. 347-364

de Bellefon R., 1999.- "L'invention du terrain de jeu de l'alpinisme : d'une montagne l'autre" *Ethnologie française* 29(1) pp. 66-78

Beniston M., Farinotti D., Stoffel M., Andreassen L. M., Coppola E., Eckert N., Fantini A., Giacona F., Hauck C., Huss M., Huwald H., Lehning M., López-Moreno J.-I., Magnusson J., Marty C., Morán-Tejeda E., Morin S., Naaim M., Provenzale A., Rabatel A., *et al.*, 2018.- "The European mountain cryosphere : a review of its current state, trends, and future challenges" *Cryosphere* 12(2) pp. 759-794

Bessy O., 2016.- "Innovations événementielles et structuration des destinations touristiques. Pour une hybridation des approches : l'exemple de l'Ultra-Trail du Mont-Blanc" *Mondes du Tourisme* (Hors-série), <http://journals.openedition.org/tourisme/1277>

Bourdeau P., 1991.- « Territoire et identité : recherches sur la territorialité d'un groupe professionnel : les guides de haute montagne en France », Université Joseph Fourier, Grenoble, <http://www.theses.fr/1991GRE19003>

Bourdeau P., 2014.- « Effet du changement climatique sur l'alpinisme et nouvelles interactions avec la gestion des espaces protégés en haute montagne ; Le cas du parc national des Ecrins », PACTE.

Chiarle M., Cat Berro D., Mercalli L., Mortara G., Nigrelli G., 2017.- "Slope instabilities occurred at high elevation in the Italian Alps in 2016 : regional landscape fragility and meteorological framework", Vienna, p 8498, <http://adsabs.harvard.edu/abs/2017EGUGA..19.8498C>

Corneloup J., Bourdeau P., 2002.- « Culture professionnelle et métiers du tourisme sportif de montagne ». *Téoros* 20(3) pp. 32-44

- Debarbieux B., 2012, « Tourisme, imaginaires et identités : inverser le point de vue ». *Tourism Review* (1), <http://journals.openedition.org/viatourism/1191>
- Einhorn B., Eckert N., Chaix C., Ravanel L., Deline P., Gardent M., Boudières V., Richard D., Vengeon J.-M., Giraud G., Schoeneich P., 2015.- « Changements climatiques et risques naturels dans les Alpes . Impacts observés et potentiels sur les systèmes physiques et socio-économiques » *Journal of Alpine Research / Revue de géographie alpine* (103-2), <http://journals.openedition.org/rga/2829>
- F. Stocker T., Qin D., Plattner G.-K., Tignor M., K. Allen S., Boschung J., 2013.- « Changements climatiques 2013, les éléments scientifiques ; Résumé à l'intention des décideurs, Résumé technique et foire aux questions. », GIEC.
- Furunes T., Mykletun R.J., 2012.- “Frozen Adventure at Risk ? A 7-year Follow-up Study of Norwegian Glacier Tourism” *Scandinavian Journal of Hospitality and Tourism* 12(4) pp.324-348
- Garcia P.-O., 2015.- « Sous l'adaptation, l'immunité : étude sur le discours de l'adaptation au changement climatique », Université Grenoble Alpes, <https://tel.archives-ouvertes.fr/tel-01470390/document>
- Godard O., 2010.- « Cette ambiguë adaptation au changement climatique », *Abstract Natures Sciences Sociétés* 18(3) pp. 287-297
- Haeberli W., Noetzli J., Arenson L., Delaloye R., Gärtner-Roer I., Gruber S., Isaksen K., Kneisel C., Krautblatter M., Phillips M., 2010.- “Mountain permafrost : development and challenges of a young research field” *Journal of Glaciology* 56(200) pp. 1043-1058
- Huss M., 2012.- “Extrapolating glacier mass balance to the mountain-range scale : the European Alps 1900-2100” *The Cryosphere* 6(4) pp. 713-727
- Joly M., Ungureanu E. I., 2018.- “Global warming and skiing : analysis of the future of skiing in the Aosta Valley” *Worldwide Hospitality and Tourism Themes*
- Kaján E., Saarinen J., 2013.- “Tourism, climate change and adaptation : a review” *Current Issues in Tourism* 16(2) pp. 167-195
- Magnin F., Josnin J.-Y., Ravanel L., Pergaud J., Pohl B., Deline P., 2017.- “Modelling rock wall permafrost degradation in the Mont Blanc massif from the LIA to the end of the 21st century.” *The Cryosphere* 11(4) pp. 1813-1834
- Mao P., 2003.- « Les lieux de pratiques sportives de nature dans les espaces ruraux et montagnards, Contribution à l'analyse de l'espace géographique des sports », Université Joseph-Fourier - Grenoble I, <https://tel.archives-ouvertes.fr/tel-00280034/document>
- Mourey J., Marcuzzi M., Ravanel L., Pallandre, 2019.- “Effects of climate change on high mountain environments : evolution of mountaineering routes in the Mont Blanc massif over half a century” *Arctic, Antarctic and Alpine Research*, <https://hal-sde.archives-ouvertes.fr/hal-01898233>
- Mourey J., Ravanel L., 2017.- « Évolution des itinéraires d'accès aux refuges du bassin de la Mer de Glace (massif du Mont Blanc, France) » *Journal of Alpine Research / Revue de géographie alpine* (105-4), <http://journals.openedition.org/rga/3780>
- Paccard P., 2009.- « Réchauffement climatique et ressource neige en domaines skiables » *Collection Edytem* 8 pp.181-192
- Perrin-Malterre C., 2016.- « Processus de diversification touristique autour des sports de nature dans une station de moyenne montagne » *Mondes du Tourisme* (11), <http://journals.openedition.org/tourisme/1012>

- Pielke R A., 1998.– “Rethinking the role of adaptation in climate policy” *Global Environmental Change* 8(2) pp.159–170
- Pröbstl-Haider U., Dabrowska K., Haider W., 2016.– “Risk perception and preferences of mountain tourists in light of glacial retreat and permafrost degradation in the Austrian Alps” *Journal of Outdoor Recreation and Tourism* 13 pp. 66–78
- Purdie H., 2013.– “Glacier Retreat and Tourism : Insights from New Zealand” *Mountain Research and Development* 33(4) pp. 463–472
- Purdie H., Gomez C., Espiner S., 2015.– “Glacier recession and the changing rockfall hazard : Implications for glacier tourism” *New Zealand Geographer* 71(3) pp. 189–202
- Purdie H., Kerr T., 2018.– “Aoraki Mount Cook : Environmental Change on an Iconic Mountaineering Route” *Mountain Research and Development* 38(4) pp. 364–379
- Ravanel L., Magnin F., Deline P., 2017.– “Impacts of the 2003 and 2015 summer heatwaves on permafrost-affected rock-walls in the Mont Blanc massif” *Science of The Total Environment* 609 pp. 132–143
- Ritter F., Fiebig M., Muhar A., 2012.– “Impacts of Global Warming on Mountaineering : A Classification of Phenomena Affecting the Alpine Trail Network” *Mountain Research and Development* 32(1) pp. 4–15
- Savelli N., 2012, « Géopolitique touristique d’un « bout du monde », le développement territorial du Valgaudemar en questions » *Journal of Alpine Research | Revue de géographie alpine* (100–2), <http://journals.openedition.org/rga/1790>
- Scott D., de Freitas C., Matzarakis A., 2009.– “Adaptation in the Tourism and Recreation Sector”, in *Biometeorology for Adaptation to Climate Variability and Change* Eds K L Ebi, I Burton, and G R McGregor (Springer Netherlands, Dordrecht), pp. 171–194, https://doi.org/10.1007/978-1-4020-8921-3_8
- Simonet G., 2015.– « Une brève histoire de l’adaptation : l’évolution conceptuelle au fil des rapports du GIEC (1990–2014) » *Natures Sciences Sociétés* 23 S52–S64
- Smit B., Wandel J., 2006.– “Adaptation, adaptive capacity and vulnerability” *Global Environmental Change* 16(3) pp. 282–292
- Swart R., Raes F., 2007.– “Making integration of adaptation and mitigation work : mainstreaming into sustainable development policies ?” *Climate Policy* 7(4) pp.288–303
- Temme A.J a M., 2015.– “Using climber’s guidebooks to assess rock fall patterns over large spatial and decadal temporal scales : an example from the swiss alps” *Geografiska Annaler : Series A, Physical Geography* 97(4) pp.793–807
- Watson C.S., King O., 2018.– “Everest’s thinning glaciers : implications for tourism and mountaineering” *Geology Today* 34(1) pp.18–25
- Zekollari H., Huss M., Farinotti D., 2019.– “Modelling the future evolution of glaciers in the European Alps under the EURO-CORDEX RCM ensemble” *The Cryosphere* 13(4) pp.1125–1146
- Zemp M., Frey H., Gärtner-Roer I., Nussbaumer S.U., Hoelzle M., Paul F., Haeberli W., Denzinger F., Ahlstrøm A.P., Anderson B., Bajracharya S., Baroni C., Braun L.N., Cáceres B.E., Casassa G., Cobos G., Dávila L.R., Granados H.D., Demuth M.N., Espizua L., et al., 2015.– “Historically unprecedented global glacier decline in the early 21st century” *Journal of Glaciology* 61(228) 745–762
tant à Chamonix contribuant à une adaptation perçue comme plus difficile.

ABSTRACTS

The evolution of the high Alpine mountain environment, especially the cryosphere that faces climate change, deeply modifies the human activities that take place there. The mountaineering routes are directly impacted and they sometimes become inaccessible. In order to recover a good balance, adaptation is necessary. Mountain guides are among the most dependent professionals on the field on which they practice. As a result, they are probably the most impacted professionals but, at the same time, they are also those who can produce a lot of adaptation strategies. The aim of this paper is therefore to identify how mountain guides from Chamonix and Courmayeur are impacted and the different adaptation strategies they developed to face climate change. By this cross-border study, using quantitative and qualitative methods, this paper is also showing that the adaptation strategies are controlled by the territory dynamics.

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Keywords: guide; high mountain; adaptation; climate change; perception

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