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Sharing Scientific Knowledge on Glaciers to the General Public: The Role of Glacier Interpretation Centres in Mountain Tourism Diversification Strategies

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Introduction

1 The ascent of Mont Blanc by H. B. de Saussure in 1787 is considered as the beginning of mountaineering, which is also an event symbolizing the starting of tourism in the European Alps (Granet-Abisset *et al.*, 2019). This technical and physical performance was accompanied by scientific experiments in order to better understand the effects of altitude on human bodies and on physical processes. Moreover, science and tourism had already been associated during the visit of the Rhone Glacier in 1708 or the Mer de Glace in 1741 (Joutard, 1986).

2 W. Windham (1741), P. Martel (1742) and H. B. de Saussure (1779 to 1796) (De Saussure, 1779–1796; Ferrand, 1912), had published their travel diaries named "Trip to the Glacières". They were quickly disseminated throughout Europe with the objective of describing their destinations and conducted scientific experiments (Guyot, 2006). For the very first tourists, scientific interest was directly associated with a sense of the picturesque; the desire "to see" accompanied by a desire "to know". More than two centuries later, these texts can be considered today as a form of "scientific mediation" that Bordeaux *et al.* (2021, pp. 2) define among others as "a set [...] of devices [aiming at] spreading knowledge, sharing science, rendering visible the cultural dimension of scientific activities and their outcomes, changing the methods of transmitting and learning science, and contributing to territorial and economic development".

3 Today, scientific mediation is no longer limited to these types of travel stories; it is also at the heart of exhibition spaces based on scientific works and is rooted in the performance of mountain stakeholders. Its challenges appear to be more significant as a growing proportion of mountain tourism activities are now threatened by climate change due to its consequences on the frequency and intensity of glaciological and geomorphological changes (IPCC, 2019). Since the end of the Little Ice Age (ca. 1850), ice volumes have halved in the Alps, and a model based on a climate scenario of +2 °C in 2100, predicts a disappearance of 80–95% of the present Alpine glacier surface (Six & Vincent, 2017).

4 Such glacier shrinkage has a significant impact on mountain tourism in general and on glacier tourism in particular. Understanding glacier tourism as a form of tourism for which the glacier is the main resource (Welling *et al.*, 2015) and the main objective of visitors (Salim *et al.*, 2021a), it is necessary to monitor and understand the extent to which it is affected by climate change on time and spatial dimensions, as glacier tourism destinations are directly threatened by the phenomenon in the Alps (Salim & Ravanel. 2020; Bourdeau *et al.*, 2021), in New Zealand (Stewart *et al.*, 2016), and in Canada (Weber *et al.*, 2019).

5 To respond to such global transformations, the stakeholders in these territories are adapting, notably through technical and marketing solutions, by developing new activity sites or by intensifying the relationships between the different stakeholders in the territory (Salim *et al.*, 2021b). Another adaptation policy is to turn the scientific value of glaciers into a tourism resource: this is the essence of scientific mediation on glacier dynamics and climate change. As a result, Glacier Interpretation Centres (GICs) are becoming a tourist attraction, providing an understanding of complex glaciological and geomorphological processes. In sum, glaciers, which used to be an attractive landscape feature, are increasingly considered by various tourism stakeholders as ephemeral and local landscape markers of more global and often fewer tangible changes. Moreover, in a context where glaciers are the major resource threatened with disappearance, it is possible that the adaptation through the creation of GICs is conceived by local operators as means of tourism diversification, or even as an innovation (Langebach & Jaccard, 2019), or as part of tourism transition emphasizing on the scientific value rather than aesthetics (Bussard *et al.*, 2022).

6 However, these centres were built in a socio-environmental perspective, have not been studied yet. Understanding the motivations and aspirations of the local stakeholders who initiated their creation of GICs, will allow us to better understand the initial territorial dynamics. Thus, the objective of this article is to assess the development processes of the Alpine GICs: the territorial dynamics at the beginning of their creation and the indicated objective or not of tourism diversification. It also aims to analyse the innovative character of these GICs and their role in tourism diversification in the context of climate change.

Research Design

Innovative Tourism Diversification

7 Tourism diversification is a strategy that leads to a more sustainable territorial development, offering services and products with added value while strengthening

links between tourism and other sectors of activity (Weidenfeld, 2018). In mountain regions, this approach was initially developed in order to move away from exclusive snow-based destinations and to cope with a dual socio-economic challenge (stagnation of the departure for winter sports, strong competition between ski resorts, etc.), and climatic context (mild winters without snow are becoming more and more frequent) (Bourdeau, 2009). In this context, the stakeholders are seeking to activate new territorial resources (Perrin-Malterre, 2016).

8 In the case of glacier tourism, the diversification strategy—which underlies the construction of GICs—is intended to "activate" the scientific value of local glaciers in a context of anthropogenic climate risks. Nevertheless, tourism innovation is a part of the rhetoric of marketing where the "newness" is one of the essential drivers of the economy; the "new" is constantly reasserted without really being effective as elaborated by Ducroquet & Viallon (2021). According to these authors, innovative tourism diversification can be claimed through several factors: such as

i. the integration of new technologies in an existing service and product;
ii. the adaptation to the local added value;
iii. the configuration and reconfiguration of the product and services;
iv. the operators providing tourism service or product for the first time and
v. the transformation of a traditional practice into an event.

9 In brief, tourism diversification is a dynamic that has been observed for decades; it is closely linked to innovation and focused on mobilising the specific local resources (Roussel, 2008).

Glacier Interpretation Centres as a Tourism Attraction

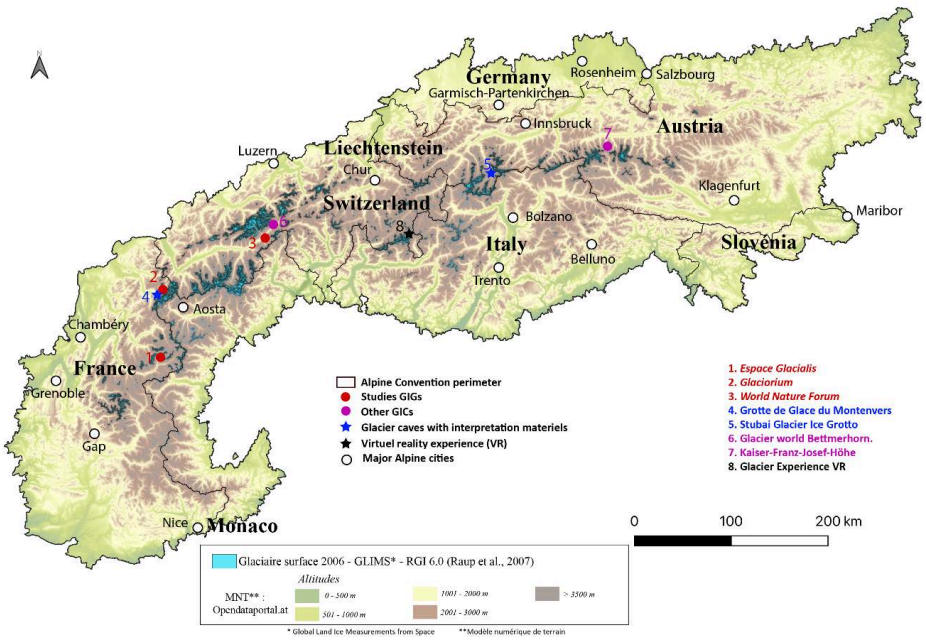
10 The concept of "interpretation centre" is increasingly used in the world of museography (Drouin, 2002). It is defined as a specific place dedicated to the dissemination of scientific contents and the promotion of cultural heritage to the general public (Chaumier & Jacobi, 2008). This concept "interpretation centre", "interpretive centre" or "visitor interpretive centre", developed in the United States and Canada in the 20th century, only appeared in France in the 2000s to complement the museum experiences with an educational and recreational dimension (Drouin, 2002; Chaumier & Jacobi, 2008).

11 In the context of this study, we define a GIC as a cultural space dedicated to the general public where glacier-related discourses and themes are dominant. Exhibitions are based on scientific mediation and interpretation tools, with or without the presence of a scientific mediator. These GICs are designed according to several methods and scenographic choices where the dissemination devices aim to share scientific knowledge about glaciers to the general public or, at least, to raise awareness on climate change issues by associating with local glaciers.

12 Referring to this definition, we conducted a search within the European Alpine Arc (Figure 1), by country (in English and in the country's own language: French, German, Italian and Slovenian). Excluding ice caves without scientific mediation purposes as well as temporary exhibitions and other museums in which the glacier theme is not dominant. We accounted 8 GICs (Figure 1), including five ad hoc centres, two ice caves

with integrated interpretation elements, and one exhibition on glacier using virtual reality.

Figure 1: GICs (FR, CH and AT) identified in the Alpine Arc



13 With the purpose of a comparative study, 3 GICs (Figure 1) have been selected for their diversity: the *Espace Glacialis* in Champagny-en-Vanoise (France), the *Glaciorium* at Montenvers - Mer de Glace (Chamonix, France), and the *World Nature Forum* (WNF) in Naters (Valais, Switzerland), which were inaugurated in 2007, 2012, and 2016 respectively. Their characteristics listed in Table 1 will be taken into account in order to achieve our research objectives.

Table 1: Major characteristics of the three selected GICs

Caracteristics	*Espace Glacialis*	*Glaciorium*	*World Nature Forum*
Courntry	Champagny-Le-Haut, France	Montenvers, France	Naters, Switzerland
Geomorphologic situation	Glacier Valley	Near by Mer de Glace	Valley
Investors	Public	Private	Public/private
Scenography	Didactic, recreational and interactive	Didactic and recreational	Didactic, recreational, interactive and virtuel experiences
Exhibition Surface	• 200 m² (ground floor and first floor)	NA*	1500 m² (ground floor and first floor)
Management	Public	Private	Foundation
Reference glacier	Glaciers of Vanoise Nationale Park	Mer de Glace – Mont Blanc massif	Great Aletsch Glacier- UNESCO
Visitors n° (2019)	1 742	NA	14 500
Visitors n° (2020)	1 578 (Covid-19 : 4 months closes)	NA	11 048 (Covid-19 : 4 months closed)
Exhibiton themes	Glaciology, interaction between human and hign mountain regions, climate change, fauna and flora ect.	Glaciology	Glaciology, agriculture and irrigation, culture of high Alpine regions, climate change, fauna ande flora ect.
Entrance fee (adult)	4 euros	free	18 CHF

* Data not available

14 The qualitative methodology is based on 15 semi-structured interviews with local stakeholders who actively participated in the creation and the management of these

centres (tourist offices, local elected officers, scientific referents, Vanoise National Park [VNP], mountain guides, GIC presenters, UNESCO, associations). The interview guide was built in order to explore several themes: information on the interviewee, the origins and development of the GIC, the current functioning and perceived roles of the GICs. It was adapted to the stakeholders whom we met.

Development of GICs into Their Territories

Espace Glacialis in the Heart of a Glacier Valley

15 The *Espace Glacialis* is located in the Champagny-le-Haut Valley in Champagny-en-Vanoise (Tarentaise). In 2020, it accounted for 16,312,600 tourists overnight, representing 30% of all nights spent in the Savoie-Mont Blanc region, 77% in winter and 22% in summer (Savoie Mont Blanc Agency, 2021). This project of *Espace Glacialis* carried by the municipality and the VNP, exists since 2012 at the entrance of the National Park, known for its high concentration of glaciers. The valley is also the starting point for many hikes and excursions in the VNP with or without landscape interpretive panels.

16 The municipality of Champagny shares with two other municipalities the highest summit of the Vanoise and of the Savoie: La Grande Casse (3,850 m). A part of the municipality is still covered by glaciers (Grand Bec, Grande Casse, Grande Motte). Created in 1963, the VNP is next to one of the largest connected ski zones in the world: Paradiski, which accounted for 3,374,500 tourists overnight for the resort of La Plagne alone during the year of 2017/18. The GIC is located 5 km from the city centre of Champagny and 27 km from Pralognan-la-Vanoise. It is indicated on maps and tourist brochures as well as on signboards, including from the municipality's city centre.

17 In 2014, the centre was awarded with the National Label "Quality Tourism", but it has no national or international recognition and has no particular marketing strategy. This may explain the limited number of visitors (1,742 visitors in 2019, Table 1). According to the municipality and the TOGP, the renovation project of the centre is currently undergoing aiming to renovate and to adjust it to the current trends and demands such as new technologies, etc.

Glaciorium, a GIC Located in an Emblematic and a Symbolic Site of the High Mountains

18 Located at the heart of the Mont Blanc Range which is very well known since the 18th century, the Montenvers - Mer de Glace site welcomes an average of more than 450,000 visitors each year (2010-19 period). According to the Compagnie du Mont Blanc (CMB), the objective of those visitors is to reach to the high altitudes (1913 m at the arrival station), to contemplate the mountain peaks and summits. According to the CMB and the Communittee of Municipality la Vallée de Chamonix-Mont-Blanc (CCVCMB), a project to re-evaluate the Montenvers site is in progress (decides in June 2021) including a project of an "International Centre for Interpretation of Glaciers and Climate".

19 In terms of marketing, the CMB is mobilizing a commercial strategy for individual and group travellers in the region, as well as in the national and international level. Its marketing strategy consists of promoting the "Mont Blanc Natural Resort" brand and its tourism products and services (ski stations, the Montenvers - site of Mer de Glace,

the Aiguille du Midi Cable cars, etc.). Despite a very easy access from the city of Chamonix by cog railway, the GIC is "lost" in the vast number of products and services promoted by the company and is suffering from a lack of visibility since very limited information are available including signboards.

World Nature Forum at the gateway to a UNESCO World Heritage Site

20 The *WNF* is located in Naters (Valais, a canton which ranked 2nd position in terms of overnight stays in 2016/18 in the Swiss Alpine Region according to the Summary report, 2020). This centre is located at the gateway to the Swiss Alps Jungfrau Aletsch, a UNESCO World Heritage site, which has at its heart the Aletsch Glacier, the largest alpine glacier. Located near Brig-Simplon, it is easily accessible by public transport such as train and bus. The majority of the exhibition in the centre is presented in English, German, French and Italian where adults and children can enjoy, "they can learn and get inspired" (*WNF*). In 2019, 14,500 national and international visitors attended this centre (Table 1).

21 In terms of marketing, according to the *WNF*, the foundation who manage the centre does not have a dedicated budget. Thus, lack of funds does not allow it to communicate beyond the national level. However, the existence of the GIC is indicated on tourist maps and it is present on social networking such as Facebook, Instagram, etc. It also has a regularly updated website and is advertising in the form of billboards in partnership with transport companies (bus and trains) and museums in Switzerland. These tools allow the *WNF* to have a decent recognition in the regional and national level.

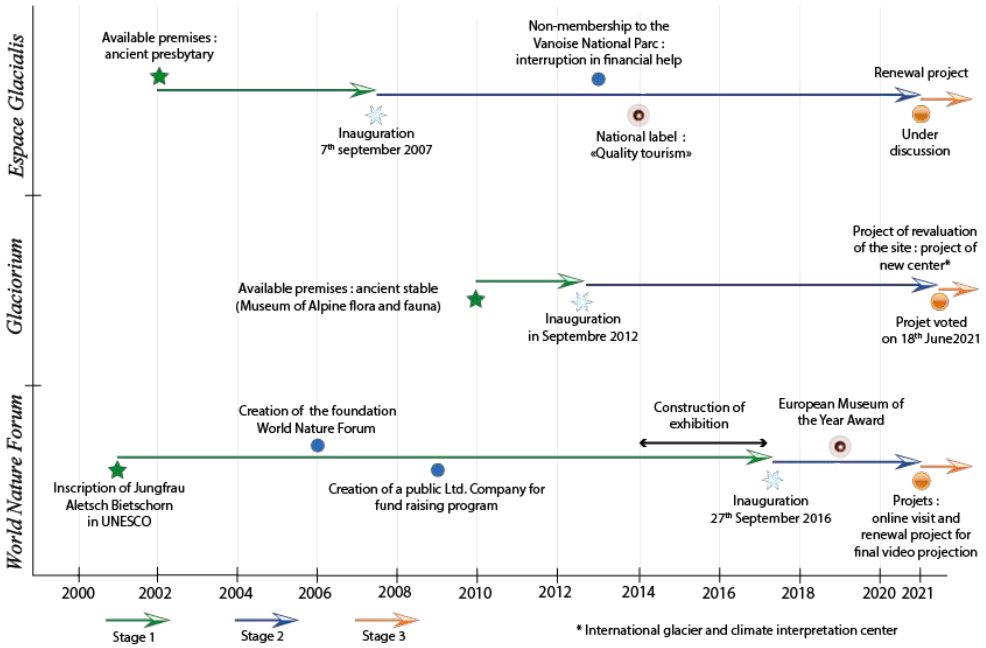
22 These three GICs are located on remarkable sites, close to the glaciers. They correspond to the implementation of a scientific mediation adapted to the general public with the objective of welcoming school groups and families (tourists and the locals). The stakeholders whom we interviewed mentioned that these centres are now attracting school groups to their territory.

23 The *WNF*, the most recent of the three studied centres, offers up-to-date and interactive exhibition than the other two, featuring interactive devices associated with senses (hearing, sight, touch and smell), touch panels, virtual experiences, etc. It has also advanced in the field of scientific education and has impressive marketing strategies. The *Espace Glacialis* and the *Glaciorium*, created in 2007 and 2012 respectively, have limited interactivity and their exhibitions are in French language with an English translation.

GIC Trajectories, Stakeholders Involved and Initial Objectives

24 The three concerned GICs have different trajectories of development (Figure 2). However, in all three cases, from the beginning of the projects, they have been conceived by local authorities as a tourist attraction which would allow the interpretation and enhancement of natural heritage, thereby facilitating a better understanding of the glacier environment and of climate change.

Figure 2: Trajectories of the GICs studied



25 Interviews with stakeholders allowed us to identify three distinct stages in the trajectories of development of these GICs:

26 **Stage 1**: Project construction with:

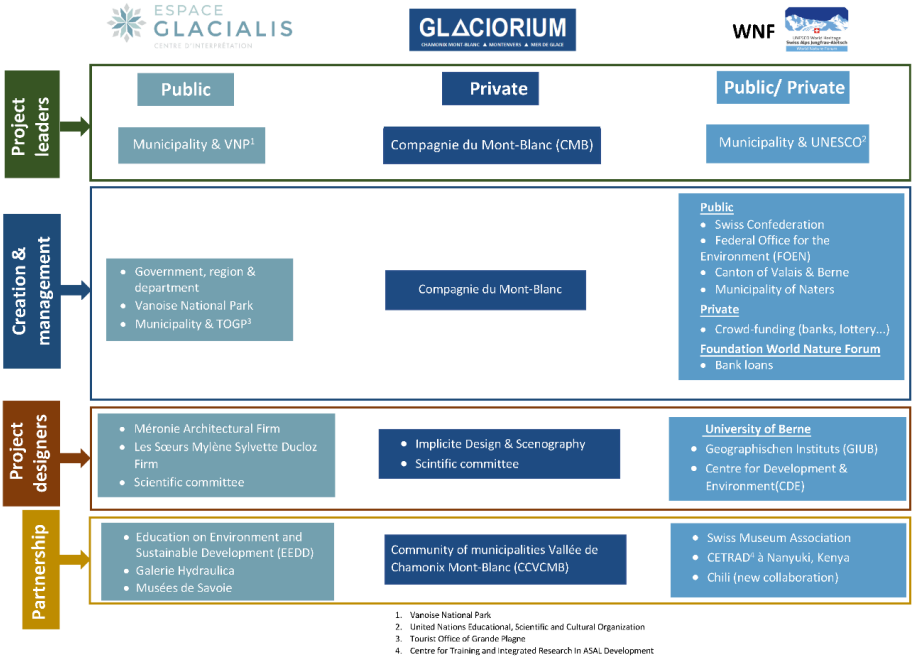
- The emergence of the concept by taking into consideration the vulnerability and the potential of the territory, the commitment of the local stakeholders for the valorization of the natural heritage made vulnerable by the climate change and the scientific value of the glacier areas;
- the design and implementation of the project based on scientific research.

27 **Stage 2**: operational and active GIC (open to the general public).

28 **Stage 3**: renovation and renewal projects.

29 This cycle of evolution is compatible with the life cycle model of the tourist destination (Butler, 1980) and adapted to a tourist product (Suchet, 2015). However, the time frame of the stages varies according to the exhibition surface, the themes dealt (Table 1) and the number of partners involved in the funding of the project (Figure 3). According to the stakeholders interviewed at *Espace Glacialis* and *WNF*, this long period of gestation between the idea and its realization (stage 1) is the result of difficulties in mobilizing funds (Figure 4) because "the most difficult thing was to find the funds" (Commune de Champagny en Vanoise and *WNF*). In contrast, the *Glaciorium*, a project financed exclusively by private funds from CMB, was built in 2 years.

Figure 3: The stakeholders involved in the creating and managing of the GICs

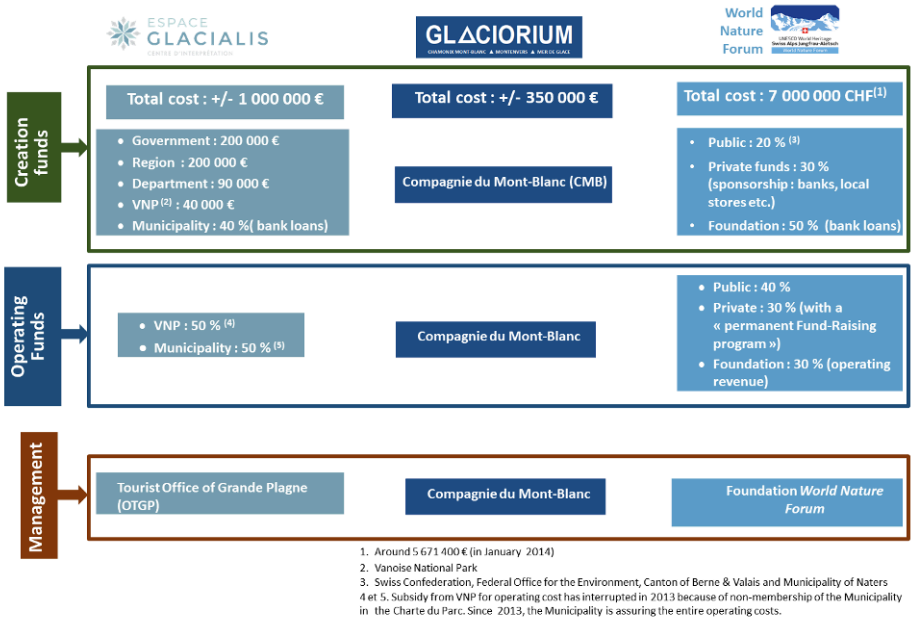


30 For *Espace Glacialis*, the concept was initiated in 2002 with the issue of the utilization of the ancient Presbytery of Champagny-Le-Haut (Figure 2). The creation of a GIC was voted and submitted to the VNP. This project, led by the Municipality and the VNP, was carried out with a budget of about 1,000,000 € (public funds) (Figure 4). Since the inauguration in 2007, management of the centre has been transferred to the TOGP and the municipality is responsible for its financing (Figure 3).

31 As for *Espace Glacialis*, the *Glaciorium* project was born in 2010, in particular because of the environmental awareness of the local stakeholders and the availability of the premises (Figure 2), an ancient stable, owned by the CCVCMB and managed by the CMB (public service delegation). This project of about 350 000 € was carried and financed by the CMB and approved by the CCVCMB (Figure 4). The management is also assured by this same company (Figure 3).

32 As for the *WNF*, the project is derived from the inscription of the Jungfrau-Aletsch site on the UNESCO World Heritage List in 2001 (the first Alpine site to be included in), with the idea of creating a centre for cooperation in the field of research and education, which has not yet been realized according to the UNESCO. This organization considers this centre as an exhibition or a simple GIC. This project carried by the municipality of Naters and UNESCO (Figure 3), the total cost was 7 million CHF (about 5,671,400 € in January 2014), divided between public, private and associative funding (Figure 4).

Figure 4: Creation and management funds



33 Most of the interviewed stakeholders are familiar with the alpine environment. They live with the present recession of glaciers and are aware of it and the climate change phenomenon. Despite the financial difficulties, they have a strong willingness to promote these natural heritages, considered as a threaten tourist destination. According to the CMB, "the idea was to give tourism a cultural and a scientific dimension," creating a complimentary to the existing services. In this regard, the interviewed stakeholders mentioned several goals associated with the realization of the GICs:

- to enhance and promote the local natural heritage;
- to maintain or develop a tourism activity.
- to transfer scientific knowledge on glaciers and their environment to the general public;
- to educate and raise awareness on climate change through glacial shrinkage phenomena;
- to allow visitors to understand the present situation and to imagine the future.

34 The interviewed scientists consider that the human activities are the most important factor of the modification of the atmosphere's composition which causes the glacier recession and climate change. Thus, for most local stakeholders, the GICs aim to reflect that "we are all responsible for the current situation". Through these GICs, local stakeholders are also encouraging visitors to visit glacier destinations that are now vulnerable due to the changing climate.

35 This form of tourism is paradoxical since the potentially long distances travelled to see endangered natural destinations contribute to their accelerating deterioration or even their disappearance (Dawson *et al.*, 2011; D'Souza *et al.*, 2021). However, visiting such centres and shrinking glaciers can provide an opportunity to witness the retreating glaciers and to become more aware and to raise awareness on climate change (Salim & Ravanel, 2020, Salim et al., 2022).

GICs as an Innovative Tourism Diversification

36 According to the interviews, the GICs are a part of the tourism diversification process of the concerned territories. Indeed, for all the project leaders, these centres are considered as a tool for developing a tourism activity that complements the existing ones. In the case of the *Glaciorium* and the *Espace Glacialis*, it is a matter of including a scientific and cultural dimension in the tourism offer without replacing the existing activities. The dynamic is somewhat different with the *WNF*, which is conceived as a centre for representing the UNESCO Heritage site.

37 Various papers regarding tourism diversification (e.g., Perrin-Malterre, 2016) showed that it is based on activating the territorial resources, defined as "an [intentionally] developed features of a specific territory, which focus on development" (Gumuchian & Pecqueur, 2007, pp. 6). In the context of climate change and according to the interviews conducted, it seems that in the example of the *Glaciorium*, the appropriation of the scientific value of the glacier as a territorial resource is the result—among other aspects—of the decreased perception of the aesthetic value of the glacier, which was previously dominant (Bussard *et al.*, 2022).

38 According to Ducroquet & Viallon (2017), the "new" being the unavoidable character of "innovation", the studied GICs now refer to a unique tourism product at the scale of their territory. Proposing a non-formal education approach, these centres are conceived in a top-down logic: the scholars transmit knowledge to the profane (Vialette *et al.*, 2021). Furthermore, the *Espace Glacialis* renovation project and the new centre planned at Montenvers seem promising in terms of innovation with the intention of local actors to integrate interactive devices (Ducroquert & Viallon, 2017).

39 According to the *WNF*, the centre has been continuously innovating since its creation by integrating new technology devices. According to Ducroquet & Viallon (2021), this management strategy is also at the heart of innovation.

Scientific Mediation at the Heart of the Ambivalent Positioning of the GIC

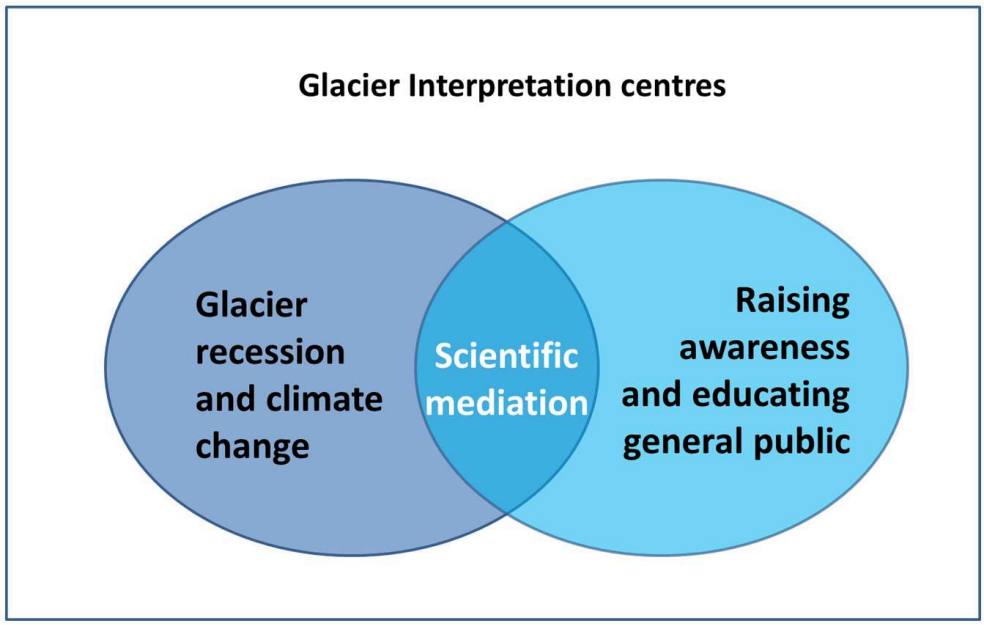
40 Although climate change and its anthropogenic causes are widely accepted by societies, particularly in France (Boy, 2020), comprehension of its process induced by their relationship with glacier retreat is complex. This is mainly because the heterogeneity of scientific conceptions and practices as well as the variety of fields concerned (Lamria, 2007). In addition, tourists are still struggling to integrate the implications of their travels in accentuating this global phenomenon (D'Souza *et al.*, 2021).

41 The exhibitions in the GICs that we studied include a wide variety of interpretive elements: educational panels, documented videos, maquettes, animations, games, interactive stations, etc. The objective of these devices is to allow visitors to better understand glacial landscapes and its dynamics, the current and future state of glaciers, climate change and its consequences, etc. According to a scenographer whom we met, these exhibitions are designed in an "educational and recreational" manner, accessible to the general public.

42 This mediation adapted to the heart of the GIC refers to a dual aspect: "sociocultural" and "spatiotemporal." This is also the case for the mining interpretation centre in

Saint-Georges-d'Hurtières (Savoie), where an interpretation of heritage was linked to the past practice. It was jointly developed by a set of local stakeholders (Boireaud, 2014). Thus, the GICs studied are a tool for enhancing a territorial specificity in danger, with an awareness of the scientific value of glacial sites (Figure 5).

Figure 5: Scientific mediation at the heart of GIC



43 For the interviewees, particularly for the scientific representatives, the objective of the visitors' awareness on climate change and glacier recession is to open up to questions such as "What can we do to improve the situation?" However, these scientific referents indicate that the theme of climate change and its consequences is addressed but in an "optimistic" way. The question of the responsibility of tourists flows in climate change is not addressed or is minimized, even though it represents, for example, around 80% of the greenhouse gas emissions of the Chamonix Valley destination (Clivaz & Savioz, 2020).

44 Here, the expression "raising awareness through scientific mediation" encounters an economic logic which creates a paradox between environmental protection—on a local and global scale—and the objective of increasing tourist numbers. This paradox is similar to the one observed in the case of last-chance tourism, where a conflict exists between the desire to protect an endangered natural heritage and its promotion as a tourism resource (Dawson *et al.*, 2011; Salim & Ravanel, 2020).

45 We also found some conflicts between investors/project leaders and scientists in terms of the adopted mediation. The scientists hope to highlight the data on climate change and the urgency of action to limit its effects and thus make visitors aware of their responsibilities, whereas the investors wish to demonstrate a consensual discourse, arguing that "visitors are on vacation", that "it is not a question of making visitors feel guilty because of their visit and their contribution to global warming", or that "this is a climatic phenomenon which perhaps will change for the better in coming years", and that "mediation should not be based on catastrophism", etc.

46 The scientists therefore sometimes feel "obliged to compromise" in terms of communication strategy and come to condemn themselves. Hence, these results bring

us to question in the relationships and exclusions between scientific mediation and economic logic. As in other tourism contexts (e.g., Gössling & Scott, 2018), the logic of mediation, or more broadly of tourism decarbonization and climate change continues not to be a salient issue in decision-making where economic logic overrides. These themes require further research to better understand the dynamics that can lead to a sustainable transition of the concerned territories.

Conclusion

47 With their similarities and their specificities, the main objective of the stakeholders during the construction of the GICs is to mobilize the scientific value of glacier landscapes and its dynamic caused by present climate change. As these projects are part of tourism diversification, they mobilize the rhetoric and tools of innovation to educate, raise awareness and familiarize visitors with the local heritage and scientific values associated with glacier environments. In terms of mediation strategies, glacier landscapes are portrayed as a tangible proof of climate change, in a recreational and educational way. The ultimate goal is to combine the visit of the GIC with a visit to the local glaciers and their surroundings to better understand the complex climate change mechanisms and glacier recessions.

48 The results show that an effort is being made by the stakeholders to present and promote the scientific value of endangered glaciers. Nevertheless, the stakeholders we met seem to remain "indifferent" or even "disengaged" and the climate issue is not being addressed in a political level. Hence, these stakeholders adopt rather an "optimistic" attitude on this subject by choice, by strategy or by professional obligation, whereas the last IPCC (2021) report and the COP 26 have demonstrated, once again, the urgency to limit global warming.

49 This suggests that the scientific mediation and exhibition contents of these centres are influenced by economic logic and that the exhibition is primarily designed to attract tourists to their territory. In this aspect, environmental awareness through the mediation adopted is clearly not the first priority of the stakeholders. However, the awareness may depend on the "experience" and the "perception" of their visit. Further studies are needs to be carried on this subject.

Interviewed Local Stake Holders

	Espace Glacialis	*Glaciorium*	*World Nature Forum*
Local Stake holders	**7 interviews** • Tourist Office of Grande Plagne • Municipality of Champagny en Vanoise (2 person) • Vanoise National Park • Scientific representative • Tourist Guide Office • Espace Glacialis	**4 interviews** • Compagnie du Mont-Blanc • Community of Municipalities Vallée de Chamonix-Mont-Blanc • Scientific representative • Implicite Design and Scénographie	**4 interviews** • Foundation World Nature Forum (2 person) • UNESCO* Chair • Association Jean-Bernard Putallaz

* United Nations Educational, Scientific and Cultural Organization

BIBLIOGRAPHY

Auer, I., Böhl, R., Jurkovic, A., Lipa, W., Orlik, A., Potzmann, R., Schnör, W., Ungersbök, M., Matulla, C., Briffa, K., Jones, P.D., Efthymiadis, D., Brunetti, M., Nanni, T., Maugeri, M., Mercalli, L., Mestre, O., Moisselin, J.-M., Begert, M., Müller-Westermeier, G., Kveton, V., Bochnicek, O., Stastny, P., Lapin, M., Szalai, S., Szentimrey, T., Cegnar, T., Dolinar, M., Gajoc-Capka, M., Zaninovic, K., Majstorovic, Z. Nieplova, E., 2007.– "HISTALP – Historical instrumental climatological surface time series of the greater Alpine region 1760–2003", *International Journal of Climatology*, vol. 27, pp. 17–46.

Boireaud, S., 2014.– "Mise en tourisme d'un site minier en Savoie. L'exemple du Grand Filon à Saint-Georges-d'Hurtières (Maurienne, Savoie)", *Collection EDYTEM*, pp. 135–146.

Bourdeau, P., 2009.– "De l'après-ski à l'après-tourisme, une figure de transition pour les Alpes : Réflexions à partir du cas français", *Journal of Alpine Research | Revue de géographie alpine*, vol. 97, n° 3. DOI: https://doi.org/10.4000/rga.1049.

Butler, R. W., 1980.– "The concept of a tourist area cycle of evolution: Implications for management of resources", *The Canadian Geographer/Le Géographe canadien*, vol. 24, n° 1, pp. 5–12. DOI: https://doi.org/10.1111/j.1541-0064.1980.tb00970.x.

Boy, D., 2020.– "Les acteurs de l'environnement", *Cairn, Futuribles*, n° 435(2), pp. 61–76.

Chaumier, S. et Jacobi, D., 2008.– "Nouveaux regards sur l'interprétation et les centres d'interprétation", *La Lettre de l'OCIM. Musées, Patrimoine et Culture scientifiques et techniques*, n° 119, pp. 4–11.

Clivaz, C. et Savioz, A., 2020.– "Recul des glaciers et appréhension des changements climatiques par les acteurs touristiques locaux. Le cas de Chamonix-Mont-Blanc dans les Alpes françaises", *Via Tourism Review*, DOI: https://doi.org/10.4000/viatourism.6066.

Dawson, J., Johnston, M. J., Stewart, E. J., Lemieux, C. J., Lemelin, R. H., Maher, P. T. et Grimwood, B. S. R., 2011.– "Ethical considerations of last chance tourism", *Journal of Ecotourism*, vol. 10 n° 3, pp. 250–265. DOI: https://doi.org/10.1080/14724049.2011.617449.

De Saussure, H. B., 1779–1796.– *Voyages dans les Alpes*, Tome 1, précédés d'un Essai sur l'histoire naturelle des environs de Genève, BnF, Gallica, pp. 145–587.

D'Souza, J., Dawson, J. et Groulx, M., 2021.– "Last chance tourism: a decade review of a case study on Churchill, Manitoba's polar bear viewing industry", *Journal of Sustainable Tourism*. DOI: https://doi.org/10.1080/09669582.2021.1910828.

Drouin, M., 2002.– "Le centre d'interprétation : un produit touristique incontournable né d'une révolution muséale", *Téoros*.

Ducroquet, A. et Viallon, P., 2017.– "Tourisme et Innovations : entre adaptations et (R)évolutions", *Mondes du Tourisme*. DOI: https://doi.org/10.4000/tourisme.1887.

Ferrand, H., 1912.– *Premiers voyages à Chamouni : lettres,...1741–1742 / de Windham et de Martel*, BnF, Gallica, pp. 51.

Gössling, S., Scott, D., 2018.– "The decarbonisation impasse: Global tourism leaders' views on climate change mitigation", *Journal of Sustainable Tourism*, vol. 26, n° 12, pp. 2071–2086. DOI: http://dx.doi.org/10.1080/09669582.2018.1529770.

Granet-Abisset, A.-M., Lorenzetti, L. et Duvillard, S., 2019.– *Territoires en miroir. Espaces d'en haut et espaces d'en bas dans les montagnes européennes (XVIe -XXIe siècles)*, Presses universitaires de Rennes, coll. "Histoire".

Guyot, A., 2006.– "Le récit de voyage en montagne au tournant des Lumières", *Societés Representations,* vol. 21, nº 1, pp. 117–133.

Gumuchian, H. et Pecqueur B., 2007.– "La Ressource territoriale", *Economica-Anthropos*.

GIEC, 2019.– "Summary for Policymakers", dans H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (dir.), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. Sous presse.

GIEC, 2021.– "Summary for Policymakers", dans V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, et B. Zhou, *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.

Joutard, P., 1986.– *L'invention du Mont Blanc*, Gallimard/Julliard.

Guillaume, J. et Huss, M., 2019.– "Future Retreat of Great Aletsch Glacier", *Journal of Glaciology*. DOI: https://doi.org/10.1017/jog.2019.52.

Lamria, C., 2007.– "Les mots de la controverse sur le changement climatique", *Le Télémaque*. DOI: https://doi.org/10.3917/tele.031.0081.

Langenbach, M. et Jaccard, É., 2019.– "L'innovation au cœur de la diversification touristique des stations de montagne ? Approche critique du rôle du trail en Suisse", *Mondes du Tourisme,* nº 15. https://doi.org/10.4000/tourisme.1936.

Mao, P. et Bourlon, F., 2011.– "Le tourisme scientifique : un essai de définition", *Téoros : revue de recherche en tourisme*, vol. 30, nº 2, pp. 94–104. DOI: https://doi.org/10.7202/1012246ar.

Pascal, M. et Bourlon, F., 2012.– "Le tourisme scientifique : Un essai de définition", *Téoros*, pp. 94–104. DOI: https://doi.org/10.7202/1012246ar.

Perrin-Malterre, C., 2016.– "Processus de diversification touristique autour des sports de nature dans une station de moyenne montagne", *Mondes du Tourisme*, nº 11.

Rapport de synthèse, 2020.– "Programme de benchmarking international du tourisme suisse : étape de projet 2018–2019", *BAK Economics AG*.

Roussel, D., 2008.– "Innovation territorialisée et nouvelles dynamiques touristiques", *Marche et organisations*, pp. 78–91.

Salim, E. et Ravanel, L., 2020.– "Last chance to see the ice: visitor motivation at Montenvers-Mer-de-Glace, French Alps", *Tourism Geographies*, pp. 1–23.

Salim, E., Gauchon, C., et Ravanel, L., 2021a.– "Seeing the Ice. An Overview of Alpine Glacier Tourism Sites, Between Post- and Hyper-Modernity", *Journal of Alpine Research | Revue de Géographie Alpine*, vol. 109, nº 4. DOI: https://doi.org/10.4000/rga.8383.

Salim, E., Ravanel, L., Bourdeau, P., et Deline, P., 2021b.– "Glacier tourism and climate change : Effects, adaptations, and perspectives in the Alps", *Regional Environmental Change*, vol. 21, nº 4, art. 120. DOI: https://doi.org/10.1007/s10113-021-01849-0.

Salim, E., Ravanel, L., & Deline, P., 2022.– "Does witnessing the effects of climate change on glacial landscapes increase pro-environmental behaviour intentions? An empirical study of a last-chance destination", *Current Issues in Tourism*, pp. 1–19. DOI: https://doi.org/10.1080/13683500.2022.2044291.

Savoie Mont Blanc Agence, 2021.– *Zoom territoire, Tarentaise*.

Six, D. et Vincent, C., 2017.– "Les glaciers de montagne, sentinelles des changements climatiques", *Encyclopédie de l'environnement*.

Suchet, A., 2015. "Pour en finir avec Butler (1980) et son modèle d'évolution des destinations touristiques. Le cycle de vie comme un concept inadapté à l'étude d'une aire géographique", *Loisir et Société / Society and Leisure*, vol. 38, n° 1, pp. 7–19. DOI: https://doi.org/10.1080/07053436.2015.1006956.

Stewart, E., Wilson, J., Espiner, S., Purdie, H., Lemieux, C. et Dawson, J., 2016.– "Implications of climate change for glacier tourism", *Tourism Geographies*, vol. 18, pp. 1–22.

Vialette, Y., Mao, P. et Bourlon, F., 2021.– "Le tourisme scientifique dans les Alpes françaises : un laboratoire pour la médiation scientifique et la recherche", *Journal of Alpine Research | Revue de géographie alpine*. DOI: https://doi.org/10.4000/rga.9337.

Weber, M., Groulx, M., Lemieux, C. J., Scott, D. et Dawson, J., 2019.– "Balancing the dual mandate of conservation and visitor use at a Canadian world heritage site in an era of rapid climate change", *Journal of Sustainable Tourism*, vol. 27, n° 9, pp. 1318–1337.

Weidenfeld, A., 2018.– "Tourism diversification and Its Implications for Smart Spécialisation", *Sustainability*, vol. 10, n° 2, art. 319. DOI: https://doi.org/10.3390/su10020319.

Welling, J. T., Árnason, Þ. et Ólafsdottír, R., 2015.– "Glacier tourism: a scoping review", *Tourism Geographies*, vol. 17, n° 5, pp. 635–662. DOI: https://doi.org/10.1080/14616688.2015.1084529.

ABSTRACTS

Climate change is a global challenge that also for glacier tourism. In the European Alps, glacial volume has decreased to one half since the end of the Little Ice Age. To confront with this evolution, local stakeholders are slowing adapting diversification on their tourism products and services. One of these adaptations concerns highlighting the scientific value of the glacier landscapes. Several Glacier Interpretation Centres (GIC) have been developed with the dual aim of spreading scientific knowledge and promoting glacier tourism destinations. Based on a qualitative approach and built in a historical and geographical perspective, this article aims to examine the territorial dynamics and the interaction of stakeholders which led to the creation of three of these centres: the *Espace Glacialis* (Champagny-le-Haut, France), the *Glaciorium* (Chamonix, France) and the *World Nature Forum* (Naters, Switzerland). Through a comparative analysis of these three GICs, the objective is to understand how the valorization of scientific knowledge contributes to the diversification of tourism in mountain areas. Although glacier tourism destinations are profoundly affected by climate change, the results show that local authorities have a strong will to continue to promote their glacier heritages through the creation and management of GICs, these centres undeniably contribute to the diversification of the tourism market and to the dynamisation of the tourism activity in their territories by relying on scientific knowledge and its mediation.

Le changement climatique est une menace globale au-delà du simple tourisme glaciaire. Dans les Alpes, les volumes glaciaires ont diminué de moitié depuis la fin du Petit Âge Glaciaire. Face à

cette évolution, les acteurs locaux s'adaptent en diversifiant leur offre touristique. L'une de ces adaptations consiste à mettre en avant la valeur scientifique des paysages glaciaires. Plusieurs centres d'interprétation glaciaire (CIG) sont ainsi aménagés dans une double logique de diffusion des savoirs et de développement touristique. Basé sur une méthodologie qualitative et construit dans une perspective historique et géographique, cet article a pour but d'étudier les dynamiques territoriales et les jeux d'acteurs ayant abouti à la création de trois de ces centres : l'*Espace Glacialis* (Champagny-le-Haut, France), le *Glaciorium* (Chamonix, France) et le *World Nature Forum* (Naters, Suisse). Par une analyse croisée de ces trois CIG, l'objectif est de comprendre dans quelle mesure la valorisation des études et des connaissances scientifiques participe à la diversification touristique des territoires de montagne. Bien que les sites glaciaires soient profondément affectés par le changement climatique, les résultats montrent que les acteurs locaux ont globalement une forte volonté de poursuivre la valorisation de leur patrimoine glaciaire par la création et la gestion de CIG. Ceux-ci contribuent indéniablement à diversifier l'offre touristique et à dynamiser l'activité touristique à l'échelle de leurs territoires en s'appuyant sur les savoirs et la médiation scientifique.

INDEX

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