Il Quaternario
Italian Journal of Quaternary Sciences
***18**(1), 2005 - Volume Speciale, 315-321*

A PROPOSAL FOR A CLASSIFICATION OF GEOMORPHOLOGICAL SITES DEPENDING ON THEIR TOURIST VALUE

Jean-Pierre Pralong & Emmanuel Reynard
Institute of Geography - University of Lausanne, BFSH 2 - Dorigny - CH-1015 Lausanne - Switzerland
Jean-Pierre.Pralong@unil.ch, Fax +41 (0) 21 692 30 75

ABSTRACT: J.P. Pralong & E. Reynard, *A proposal for a classification of Geomorphological sites depending on their tourist value*. (IT ISSN 0394-3356, 2005).
This paper presents theoretical frameworks concerning the relationships between geomorphological landforms and processes and tourist and recreational activities. Firstly, a global model connecting different components of these relationships is proposed. Secondly, a particular model analysing how geomorphological landforms and processes are recognised and assessed as geomorphological sites in a context of tourist optimization and exploitation is developed. Finally, an ensuing classification of geomorphological sites according to the use of their scenic, scientific, cultural and economic values is developed and illustrated by two case studies in the area of Chamonix-Mont-Blanc (Haute-Savoie, France).

RIASSUNTO: J.P. Pralong & E. Reynard, Proposta per la classificazione di siti geomorfologici basata sul loro valore turistico*. (IT ISSN 0394-3356, 2005).*
L'articolo presenta tre quadri teoretici concernenti le relazioni tra forme e processi geomorfologici da una parte e attività ricreative e turistiche dall'altra parte. Viene proposto prima un modello globale che mette in evidenza le differenti componenti di tali relazioni. E' poi sviluppato un modello che analizza come vengono riconosciuti e valutati i siti geomorfologici in un contesto di valorizzazione e di sviluppo turistico. Infine, viene sviluppata una classificazione dei siti geomorfologici secondo il loro valore scenico, scientifico, culturale ed economico, che viene poi illustrata con due esempi nella zona di Chamonix-Mont-Blanc (Alta Savoia, Francia).

Keywords: Geomorphological sites, Landscape, Tourist offer, Environmental impacts, Natural risks, Chamonix-Mont-Blanc.

Parole chiave: Siti geomorfologici, Paesaggio, Offerta turistica, Impatti ambientali, Rischi naturali, Chamonix-Mont-Blanc.

1. INTRODUCTION

The relationships between geomorphology and tourism may be analysed in four ways (Reynard *et al*., 2003) at the interface of the natural and socio-economic systems:

1. First of all, geomorphology may be a tourist resource as part of the primary or *original offer*, that means as an element of the landscape or as a support for particular activities (e.g. climbing, canyonning, etc.). In this sense, geomorphology is a potential for tourist development, a part of the attraction of a tourist site;
2. Geomorphology may also be part of the secondary or *derived offer*, when tourist infrastructures (e.g. museums, didactic paths), instruments (e.g. pedagogic booklets) or services (e.g. guided visits) are proposed for optimizing the original offer;
3. Geomorphological processes may create *changes* on the tourist and recreational activities and infrastructures (processes, hazards and risks);
4. Tourist activities and development may also create impacts on geomorphological processes and forms (e.g. soil erosion, slope instability or landform destruction).

The aim of this article is mainly to consider the first three points and also to propose a theoretical reflection about the relationships between geomorphological landforms and processes and tourist and recreational activities. Thus, three frameworks will be developed: the first one as a global model at the interface of the natural and socio-economic systems, the second one as a model of optimization and exploitation in a tourist context, the third one as a classification allowing to distinguish various types of geomorphological sites. As application examples, two case studies, related to the Mer de Glace and Bossons glaciers, in the area of Chamonix-Mont-Blanc (Haute-Savoie, France), will be presented.

2. STUDIED AREA

The Chamonix-Mont-Blanc region (Fig. 1) is situated in the *Arve valley* (Haute-Savoie, France). The studied area concerns the river floor (Chamonix area) and the right (*Massif des Aiguilles Rouges*) and the left sides (*Massif du Mont-Blanc*) of the valley. Chamonix is a small town of 10.109 permanent inhabitants (census 1999) and is one of the largest ski resorts in France with 4.630.000 nights in 1999 (Debarbieux, 2000). The major economic income of the region comes from tourism (skiing, golf, hiking). Winter tourism is largely predominant, but new forms of summer tourism (trekking, biking) are developing, especially on the right side, beside various natural reserves (*Aiguilles Rouges, Carlaveyron*).

From a geological point of view, the area is situated in the Helvetic domain, composed principally by gneiss and granites from the Aiguilles Rouges and the Mont-Blanc units (Espace Mont-Blanc, 2001). These two units are separated by the Chamonix area situated

in the valley floor and composed principally by limestones, marls and sandstones. Morphologically, the valley floor is covered by glacial and alluvial deposits (Dorthe-Monachon, 1986) and the right side presents a lot of famous glaciers (Tour, Argentière, Mer de Glace, Bossons, Bionnassay) whereas the left side is practically deprived of ice and presents a lot of lakes and wetlands.

3. CONCEPTUAL FRAMEWORKS

3.1. General framework

The Figure 2 presents the relationships existing between geomorphology and tourism. Tourist use of geomorphological landforms is made through the exploitation of geomorphological sites (1). *Geomorphological sites* (or geomorphological assets) are defined by Panizza & Piacente (1993; 2003) and Quaranta (1993) as geomorphological landforms (and processes) that have acquired a scenic, scientific, cultural/historical and/or social/economic value due to human perception or exploitation. In our case, they can be considered as geomorphological landforms and processes (e.g. geysers, active volcanoes, glaciers) that have acquired a certain tourist value and that are optimized and exploited for tourist purposes.

In that sense, geomorphological sites may be considered as part of the *original* (*or primary*) tourist offer (2), which can be defined as the whole of natural, social, cultural or historical features that produce the attraction of a site (Barras, 1987). According to Debarbieux (1995), the primary offer depends on the localisation of the landforms and tourists have to go *in situ* in order to obtain satisfaction. In the case of geomorphology, the original offer can be completely based on the presence of a geomorphological landform or process. The tourist attraction of the small village of *La-Chaux-les-Passavants* in the French Jura is for example only due to the presence of an ice cave. On the other hand, geomorphology may represent only one part of the tourist value of a site or a region. To take an example, the sugar loaf is not the only reason for tourists to visit Rio de Janeiro.

However, geomorphology is not only limited to the original offer. A site may become a tourist destination only if amenities (infrastructures, services) are proposed to the visitors (Barras, 1987), in order to facilitate their staying and access. Thus, the secondary offer

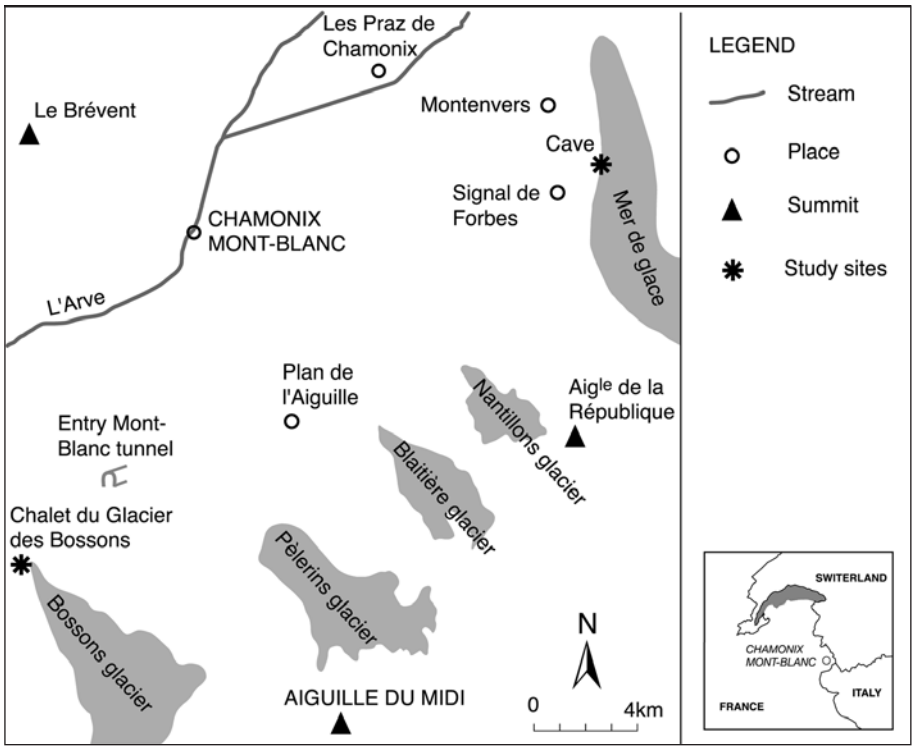

Fig. 1 - Map of the studied region. Chamonix-Mont-Blanc (Haute-Savoie, France).
Carta della regione studiata. Chamonix-Mont-Blanc (Alta Savoia, Francia).

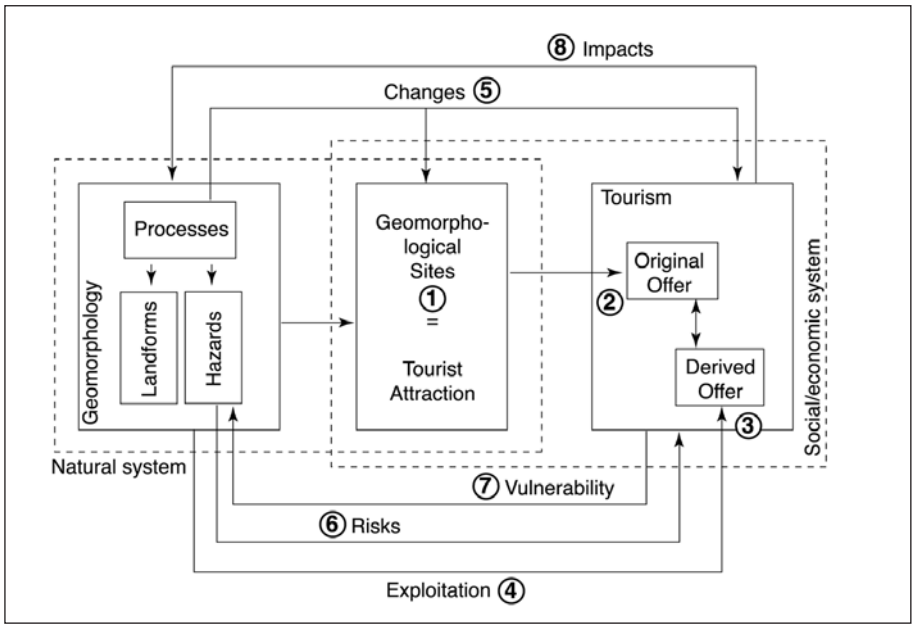

Fig. 2 - Relationships between geomorphology and tourism: conceptual framework (adapted from Panizza, 2003 and Reynard *et al.*, 2003).
Relazioni tra geomorfologia e turismo: quadro concettuale (adattato da Panizza, 2003 e Reynard et al.*, 2003).*

depends on the localisation of the population and tourists have to go *ex situ* in order to gain satisfaction (Debarbieux, 1995). That is the *derived* (*or secondary*) *tourist offer* that may be unspecialised (e.g. parking, tourist office, hostels, roads and railways, etc.) or specialised (e.g. guided visits of a cave, presence of ski lifts in a winter resort, etc.). Exploitation of geomorphology for tourism needs a specialised secondary offer (3), that means services (e.g. the presence of specialised guides), instruments (e.g. didactic boards, booklets, etc.) or infrastructures (e.g. transportation facilities for accessing specific geomorphological points, museum), that allow the exploitation (4) of the geomorphological sites. Thus, these two types of offer create goods and services for material uses (hiking, climbing) and immaterial uses (relaxation, contemplation).

Relationships between geomorphology and tourism are not limited to the exploitation of a site, based on the original and derived offer. It is also a question of changes, risks and impacts. On the one hand, geomorphological processes may create changes on tourism (5), especially geomorphological hazards as landslides, avalanches, floods, rockfalls, etc., which create a relationship of risks (6). Landslides or floods may for example destroy tourist villages. In this sense, tourist offer is in a situation of vulnerability (7). On the other hand, tourist activities create impacts on geomorphological processes and landforms (8) (Panizza, 2003). Impacts may be negative or positive and direct, induced or indirect (Cavallin *et al*., 1994).

3.2. Optimization, exploitation and transformation of geomorphological sites

More precisely, in order to understand how the relationships between geomorphology and tourism act in the case of tourist development, a second conceptual framework is proposed in Figure 3. According to this model, three steps are considered: optimization, exploitation and transformation.

The onset is the existence of landforms and processes, expression of the Earth's history (1), as well as geological items. By human perception, geomorphology is considered (or not considered) as interesting for tourist purposes. Thus, landscapes with a certain scenic, scientific, cultural/historical and/or social/economic value are optimized (2) as (tourist) geomorphological sites. The optimization depends of the degree of ecological (or geomorphological) sensibility of the tourist actors. When clear ecological ideas are expressed, optimization of geomorphological sites may happen.

As a result of an ecological stimulation, tourist developers have two possibilities of action: protection (3) and/or exploitation (4). Protection may happen when geomorphological sites are particularly vulnerable to human presence (e.g. some wetlands). Geomorphological sites may also be exploited by the tourist industry[1] and in that sense, they become the basis for tourist project conception and implementation (e.g. tourist caves, natural parks, didactic paths, etc.) by social stimulation. The project implementation creates a derived offer and the sustainability of the project depends of the type of management (5), following the use of geomorphological site values (see Fig. 4).

When the project is fulfilled, it may transform (6) the geomorphology and create direct or indirect impacts and induced hazards, that modify (in a positive or a negative way) the original processes and landforms, as a result of the economic stimulation. Examples of transformations are the destruction of speleothems by the opening of caves to tourist visits (direct impact), the decreasing of the intensity of processes responsible for bad-lands formation in the case of the creation of protected areas and parallel reduction of livestock activity (indirect impact), and the increase of erosion (and successive landslides and debris flow hazards) due to the creation of ski tracks in mountain areas (induced hazards).

These anthropic modifications are recorded as Earth history memory and cultural witnesses (1). Geomorphological landforms and processes of a second generation are therefore created and also new geomorphological sites in the sense of "tourist landscape evolution". We assume that sustainable tourist use of geomorphological sites is reached when they produce sufficient financial incomes without negative environmental impacts and in base of a global consensus between the various actors (tourist actors, visitors, land owners, NGOs, etc.).

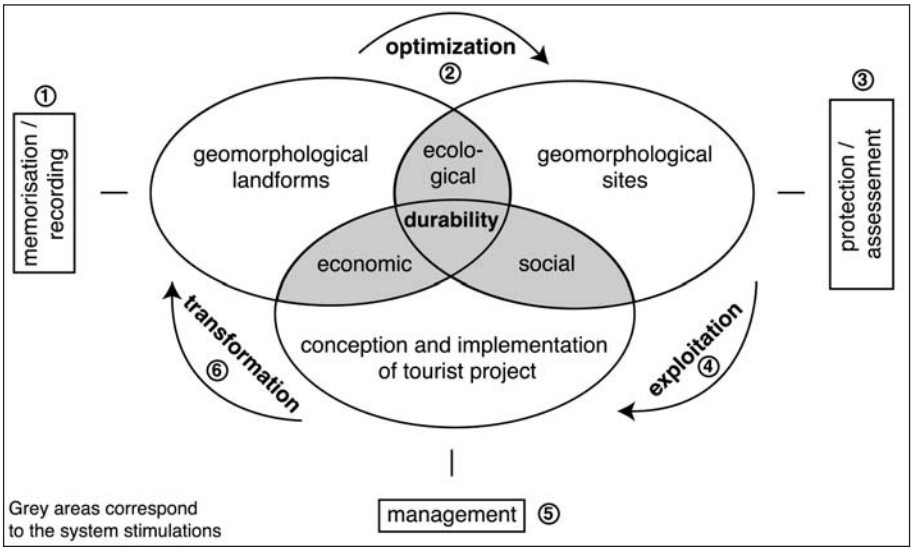

Fig. 3 - Conceptual model describing the optimization, exploitation and transformation of geomorphology in a context of tourist development.

Modello concettuale che descrive la valorizzazione, l'uso e la trasformazione della geomorfologia in un contesto di sviluppo turistico.

[1] Note that protection and exploitation are not exclusive and may happen simultaneously: that is for example the case in natural and national parks. Some areas or objects are strictly protected and sometimes human access is prohibited (e.g. the central part of a national park), whereas other parts are open for tourist visits.

4. CLASSIFICATION OF GEOMORPHOLOGICAL SITES

The comprehension of the relationships evidenced in Figure 2 and 3 allows the classification of geomorphological sites related to their optimization, exploitation and transformation due to tourist and recreational activities. A typology is therefore presented on Figure 4. Three categories are proposed: geomorphological sites (in the strict and the broader sense) and geomorphological mediums.

According to Panizza & Piacente (1993), geomorphological sites are created by the contact between geomorphology and society, more precisely by the human perception of the value of geomorphological processes and landforms (A). With this process of optimization, they acquire a certain scenic, scientific, cultural/historical and/or social/economic value due to geological, geomorphological, historical and social factors. Three groups of geomorphological sites are possible to be defined according to their value (B):

1. If the scenic, scientific or cultural value is concerned at least, without taking into account the economic value, geomorphological assets are defined as geomorphological sites in the strict sense. These items can be exploited or not (C). In this case, exploitation should be understood in terms of protection (total, with no possibility of human use), which means without any tourist activities in the surrounding of the landforms. Therefore, if a geomorphological site (in the strict sense), according to its value, is protected, it becomes a protected geomorphological site. Otherwise, it stays a geomorphological site in the strict sense.
2. If the scenic, scientific, cultural or economic value is considered, geomorphological assets are defined as geomorphological sites in the broader sense. In this case, landforms may have a tourist function if they are exploited (C) and sometimes protected (partially, with possibility of human use). Thus, geomorphological sites (in the broader sense) are considered as a tourist and cultural resource (with extensive or intensive use). In this case, the question of sustainable management of geomorphology is essential; a too-intensive use of geomorphology may dramatically change the value(s) of the resource and therefore its classification.
3. Finally, if only the economic value is taken into account, geomorphological assets are simply defined as geomorphological mediums (framework, support), without any cultural value (e.g. rock glacier destroyed by ski tracks creation). In a context of tourist development, the exploitation of this type of feature (C) creates a tourist and economic resource (with extensive or intensive use); without exploitation, landforms can simply be called geomorphological mediums.

For all the six classes, natural and/or anthropic transformation (D) may happen due to tourist activities and infrastructures or geomorphological processes and hazards. Thus, tourist projects may affect the geomorphological sites and mediums, creating direct, indirect or induced impacts and risks (after Cavallin *et al*., 1994).

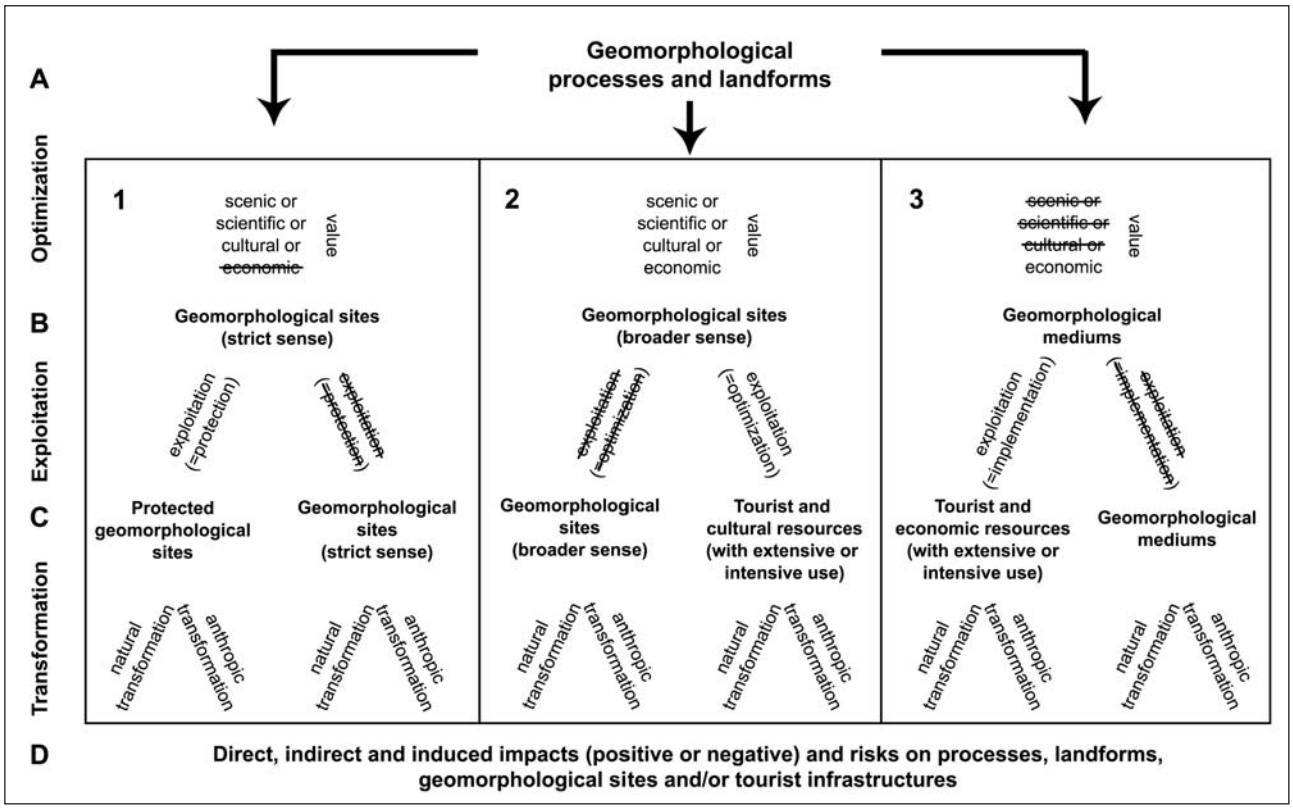

Fig. 4 - Classification of geomorphological sites according to their values in a context of tourist development.
Classificazione dei siti geomorfologici secondo i loro valori in un contesto di sviluppo turistico.

5. APPLICATION EXAMPLES

The proposed classification (Fig. 4) may be used for assessing sustainability of tourist use of geomorphological sites. Two examples in the area of Chamonix-Mont-Blanc (Haute-Savoie, France) are proposed here as application examples of differential exploitation: the Mer de Glace glacier and the Bossons glacier (see Fig. 1 for location). This comparison may be interesting to illustrate the range between a "tourist and economic resource (with extensive or intensive use)" and a "tourist and cultural resource (with extensive or intensive use)".

5.1. Case study 1: the Mer de Glace glacier

The *Montenvers* is the final station (1930 m) of a mountain train allowing the access to a wonderful viewpoint of the Mer de Glace glacier (40 km^2) which is the third largest glacier in the Alps in terms of volume (Moreau & Vivian, 2000) after the Aletsch glacier (120 km^2, Valais, Switzerland) and the Gorner glacier (65 km^2, Valais, Switzerland).

From the *Montenvers* station, the access to the Mer de Glace is possible by a cable car, very impressive in terms of visual impact, or on foot by an established path. The tourist attractions linked to the glacier (Fig. 5) are a glacial cave (on the right), dug out each spring and autumn for numerous years because of the glacier advance, and an "ice garden" (on the left), a space of pedestrian discovery allowing a walk on a small part of the glacier. In practice, there is a fee to visit the two attractions, which require a daily maintenance in reason of the glacial flow and the abundance of visitors (sometimes near to 6.000 per day according to Ballu, 2002).

Inside the cave, some rooms and elements of the traditional and regional mountain way of life have been carved out (kitchen, bedroom, bathroom, lounge). Furthermore, it is possible to have a photo taken with *Beethoven*, a *St-Bernard* dog, with a little typical "*chalet savoyard*" behind it. The walk is regulated by path boards and ends with the cave. No explanation about the glacial dynamic or the ice structure is proposed during the visit. Only a tourist leaflet about the cave and the *Montenvers* site is available at the cash-box, indicated by a signal board only visible after the visit!

Concerning the "ice garden", created in summer 2002, the access is possible by the bridge of the cave (Fig. 5). Then, tourists can walk freely on a part of the glacier measuring about 30 meters by 70 meters, where a lot of glacial forms and micro-forms are visible (erratic blocks, supraglacial moraine, ice sheets, dirt cones, moulin, etc.). As in the cave, there are no explanations (didactic paths, leaflets, or guided visits) about these landforms and the glacier. Furthermore, advertisements about this spot are so limited (e.g. just a few brochures are available at the railway station in Chamonix), that this new recreational offer is considered by some tourists as a work site!

In comparison with the number of people visiting the cave, few people are interested by this spot which, on the one hand, is completely secure (presence of hazard signboards, carpet on the ice, barriers limiting the space) and on the other hand, has not had the entry price to the site enhanced since its making. So, for the actors managing the site (cave and "ice garden" included), the aim of the exploitation is not to give didactic and cultural information, but to welcome a maximum of people in a profit earning logic, especially during the period of high abundance (summer season).

Fig. 5 - Mer de Glace glacier with its numerous artificial caves and its "ice garden". Chamonix-Mont-Blanc (Haute-Savoie, France).

Ghiacciaio del Mer de Glace con numerose grotte artificiali e il suo "giardino glaciale" *Chamonix-Mont-Blanc (Alta Savoia, Francia).*

In this case, the primary offer (natural glacier) has become less important in terms of exploitation than the secondary offer (artificial glacial cave, "ice garden", cable car, established paths). The tourist value of the glacier seems to have been emptied of its cultural and scientific values by the economic value in an intensive and "uncultural" manner. But the impacts on the glacier (and not in the surroundings) are not necessarily negative and give a new scenic and cultural value to the Mer de Glace. Thus, by a tourist landscape evolution, these new values have created a geomorphological landform of a second generation.

5.2. Case study 2: the Bossons glacier

The Bossons glacier - one of the rare large white glaciers in the Alps (Fig. 6) - is the longest glacial slope in Europe (3500 m), with a tongue flowing down to 1350 meters (Mollier, 2000).

One of the best tourist viewpoints to see the glacier is the "Chalet du glacier des Bossons" (1425 m) which is a little restaurant accessible by a little cable car or on foot from the Bossons village. The restaurant is built on the left lateral Little Ice Age moraine of the Bossons glacier, and composed especially by erratic blocks of granite from the Mont-Blanc unit.

In summer, the tourist attraction is the sight of the glacier front, which presents a wonderful white colour and frequent ice avalanches. From the "*Chalet du glacier des Bossons*", two viewpoints (gratis) can be reached; the first one at 1425 meters and the second one at about 1460 meters. A didactic path (with 10 boards) allowing the glacial flow and history and movements of the Bossons glacier to be understood embellishes the ascension to the last viewpoint.

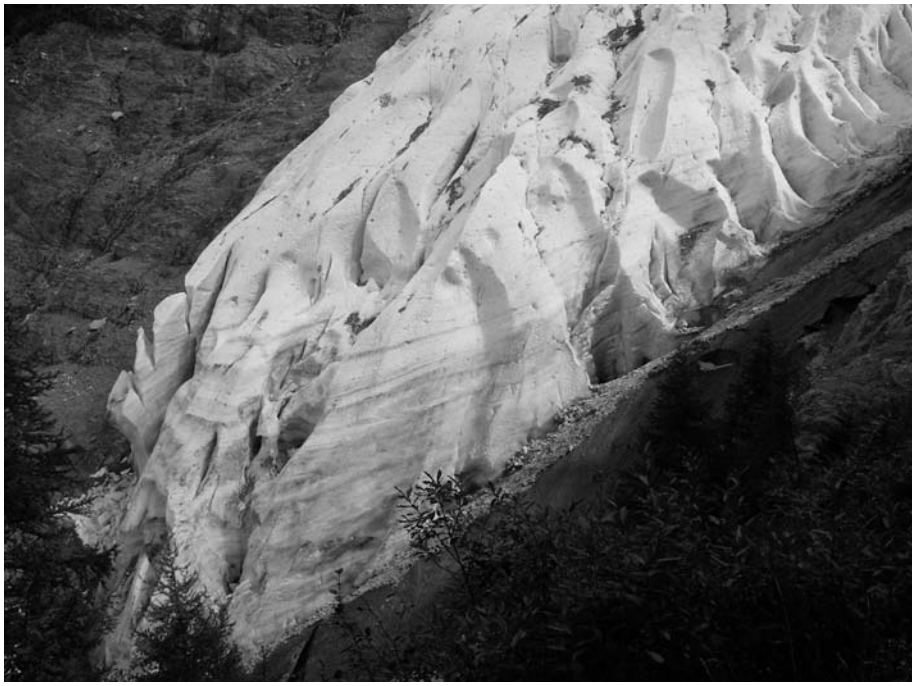

Fig. 6 - Front of the Bossons glacier from the viewpoint of the "*Chalet du glacier des Bossons*". Chamonix-Mont-Blanc (Haute-Savoie, France).

*Fronte del Bossons ghiacciaio visto dal "*Chalet du glacier des Bossons*". Chamonix-Mont-Blanc (Alta Savoia, Francia).*

Concerning the didactic path, the pathway is quite inclined and narrow. Furthermore, each board is an unprofessional set-up of copies of scientific books (texts and pictures) and the content apparently interests visitors who go to the viewpoint. Finally, some didactic leaflets about the Bossons glacier, perhaps used as tools for guided and cultural visits, are available for sale at the kiosk of the restaurant.

Thus, this tourist attraction was not created for an important abundance – as is actually the ice cave of the Mer de Glace glacier - and is an example of extensive and cultural site exploitation. Furthermore, visits do not create vulnerability, risk and impacts in relation to the glacier, because it is impossible to access to its (dangerous) front and to walk on and into the glacier[2].

In comparison with the Montenvers site, the Bossons glacier is completely different in terms of slope, colour and features, and also in terms of the use of values, risk and impacts, because, for the actors managing the site, the aim of the exploitation is to deliberately propose another way to discover a famous glacier. Here, the economic value of the glacial landform is used without trashing its scientific and cultural values.

Finally, in this case, the primary offer (natural glacier) remains more important in terms of exploitation than the secondary offer (restaurant, pathway, didactic path, viewpoint). The tourist landscape evolution is more natural and the glacier has not really acquired a new scenic and cultural value (no value renewal), and also remains a geomorphological landform of the first generation.

[2] Before the age of mass tourism, there was a tourist ice cave into the Bossons glacier. Now, some guided visits are organised for walking on the glacier.

6. CONCLUSION

In the relationships between geomorphology and tourist and recreational activities, three main elements are necessary to be studied: geomorphological sites optimization and exploitation, environmental impacts and natural risks. Our study has especially considered the first one.

For an understanding of the tourist and cultural evolution of landscapes and geomorphological sites, a step-by-step reflection in terms of optimization, exploitation and transformation is relevant. The proposed classification, depending on the scenic, scientific, cultural/historical, and social/economic value of the geomorphological items is based on this idea and shows three categories of geomorphological sites (geomorphological sites in both the strict sense and the broader sense) and geomorphological mediums segregated by the economic value.

This method may be interesting for analysing the differential uses of geomorphological sites. We assume that the degree and the modalities of exploitation follow the various values given to geomorphological sites; the comparison between the Mer de Glace (tourist and economic resource) and the Bossons glaciers (tourist and cultural resource) is in this way exemplary.

The two examples (both concerning the Chamonix area, Haute-Savoie, France) show that the differences in terms of geomorphological sites optimization and exploitation, environmental impacts and natural risks are not well understood in the simple distinction between soft and hard tourism, because tourist landscape evolution is influenced by a single

human perception of the actors. Such evolution can create different generations of geomorphological sites, whose values evolve.

Finally, a statement can be done: when the geomorphological resource becomes just a consumable product, the exploitation seems to be more oriented on the secondary offer and the impacts and risks are higher. Also, less the actors managing the geomorphological resource take the scientific and cultural value into account, more the renewal of the resource tends to decrease.

ACKNOWLEDGEMENTS

We strongly acknowledge our colleagues geomorphologists at the Institute of Geography of the University of Lausanne, especially N. Summermatter, for their useful comments, as well as the helpful criticisms of two anonymous reviewers.

REFERENCES

Ballu Y. (2002) - *Drus, Montenvers et Mer de Glace* - Paris, Hoëbeke, 141 pp.

Barras C.V. (1987) - *Le développement régional à motricité touristique. De la région polarisée à la région-système* - Documents économiques, **33**, Fribourg, Editions Universitaires, 285 pp.

Cavallin A., Marchetti M., Panizza M. & Soldati M. (1994) - *The role of geomorphology in environmental impact assessment* - Geomorphology, **9**, pp. 143-153.

Debarbieux B. (1995) - *Tourisme et montagne* - Paris, Economica, 107 pp.

Debarbieux B. (2000) - *Bilan critique de 50 ans de tourisme à Chamonix* - Rapport n° 1, Urbanisation - Aménagement, Politiques touristiques, Représentation sociales (http://www.sommets-tourisme.org).

Dorthe-Monachon C. (1986) - *Contribution à l'étude de la morphologie glaciaire de la vallée de l'Arve (Haute-Savoie, France) : essai de reconstitution paléogéographique* - Thèse de doctorat présentée à la Faculté des Lettres de l'Université de Lausanne, 249 pp.

Espace Mont-Blanc (2001) - *50 sentiers à thèmes dans l'Espace Mont-Blanc*. Haute-Savoie, Savoie, Valais, Vallée d'Aoste, Grenoble, Glénat, 239 pp.

Mollier C. (2000) - *Du glacier du Mont-Blanc au glacier des Bossons* - Yens, Cabédita, 131 pp.

Moreau L. & Vivian R. (2000) - *Dans le secret des glaciers du Mont-Blanc* - Grenoble, Glénat, 95 pp.

Panizza M. (2003) - *Géomorphologie et tourisme dans un paysage culturel intégré* - In: E. Reynard, C. Holzmann, D. Guex & N. Summermatter (eds.), *Géomorphologie et tourisme*, Actes de la Réunion annuelle de la Société Suisse de Géomorphologie (SSGm), Finhaut, 21-23 septembre 2001, Lausanne, Institut de Géographie, Travaux et Recherches, **24**, pp. 11-20.

Panizza M. & Piacente S. (1993) - *Geomorphological assets evaluation* - Zeitschr. für Geomorphologie N.F., Suppl. Bd., **87**, pp. 13-18.

Panizza M. & Piacente S. (2003) - *Geomorfologia culturale* - Bologna, Pitagora, 350 pp.

Quaranta G. (1993) - *Geomorphological assets : conceptual aspect and application in the area of Crodo da Lago (Cortina d'Ampezzo, Dolomites)* - First European Intensive Course on Applied Geomorphology, Proceedings, Modena - Cortina d'Ampezzo 24 June - 3 July 1992, pp. 49-60.

Reynard E., Holzmann C. & Guex D. (2003) - *Géomorphologie et tourisme: quelles relations?* - In: E. Reynard, C. Holzmann, D. Guex & N. Summermatter (eds.), *Géomorphologie et tourisme*, Actes de la Réunion annuelle de la Société Suisse de Géomorphologie (SSGm), Finhaut, 21-23 septembre 2001, Lausanne, Institut de Géographie, Travaux et Recherches, **24**, pp. 1-10.