

EXEMPLARY ACTIONS OF EDUCATION FOR INCREASING THE RESILIENCE OF COMMUNITIES TO
NATURAL HAZARDS IN HIGH MOUNTAIN

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ABSTRACT: In response to actual climatic variations and global warming, highlighted by the scorching summers of 2003 and 2015, major alpine faces within the Mont Blanc Massif show major destabilizations, making high mountain environments riskier. In addition, mountain sports evolved and are, now, more focused on racing. Information policies and public awareness on natural hazards, addressed especially to young audience, are becoming a priority.

Accordingly, the Fondazione Montagna Sicura (Courmayeur, Italy), La Chamoniarde (Chamonix-Mont-Blanc, France) and other major research institutes gathered to respond to this new issues.

The PrévRiskHauteMontagne Project, as a part of P.O. Italy-France 2014-2020 (Alcotra) focuses on improving mountain safety for mountaineers, skiers, etc., in regards to new high-mountain objective risks (especially, avalanches, permafrost and glacial hazards).

New innovative actions for information, education and awareness-raising will be launched throughout the Mont-Blanc Massif, both in France and Italy. This includes, for example, setting up ARTVA fields and creating a smartphone application for snow and weather reports.

In the meantime, scientific investigations and monitoring will ensure the understatement of these new phenomenas (e.g. snow-brige creation and evolution surveying, real-time camera-based serac monitoring...)

Following this global process, the general radio network will be improved by a new sender-receiver supply that will cover previously uncovered GSM areas of the Massif. Moreover, mountain rescue trainings will be organized for Swiss, Italian and French Search and Rescue specialists in order to share experience, skills and techniques.

This project gathers mountain safety specialists and professionals alongside state-of-the-art research laboratories, universities and local community representatives. It follows a ten-years collaboration aiming at building a resilient community and targeting at large audiences (children and teenagers, mountain enthusiasts and professionals).

KEYWORDS: mountaineering, natural hazards, education, resilience, risks.

1. ALPINE ENVIRONMENT - INTRODUCTION

IPCC scenarios, already in the synthesis report of the 2007, indicate the Alps as one of the most sensitive areas to climate change. Due to warming temperature and changing precipitation patterns, modification can especially affect glaciers and snow cover, two of the most significant elements of alpine mountain ranges. As a consequence, impacts on economy and society are expected, as well as an increase in natural hazards and therefore higher risks for mountain valley population.

Zemp et al. (2006,2007) used a distributed model of equilibrium line altitude (ELA) to simulate variations of the glacierized area of the entire Alpine range for the 1971-90 reference period and climate change scenarios for the 21st century. Their studies showed that a summer temperature increase of +3°C (which corresponds to about +2°C from present days) and would reduce the total Alpine glacier area of the reference period by 80% (Voigt et al. 2010).

These climate scenarios involve modifications in natural hazards in high mountain regions. Adaptation and special measures of governance are now needed, as well as an adequate education for all population even for mountain enthusiasts.

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On July 17th 2015, due to a particularly strong heat-wave increasing the number of rock falls on the normal route to Mont Blanc, French authorities decided, after several fatalities, to close this itinerary.

This year, a large crevasse appeared at 4.700m of elevation, making the normal route of the Mont-Blanc a more technical itinerary. With the will to make the ascent easier for their clients, some guides, with the help of the local community, decided to build an ice ramp (Fig. 1). This example highlights the strong link between high mountain environment and local economy.



Fig. 1: Guides building the ice ramp on the crevasse of the Mont-Blanc normal route, July 2016 (copyright: *Compagnie des Guides de Saint-Gervais*)

Another aspect to consider is that mountain sports evolved and are, now, also focused on racing. In the past winter season (from late November 2015 to mid-April 2016) over 180 alpine ski races were held on the Italian side of the Alps. Even if the absolute number of participants remains unknown, it emerges that the discipline has been growing and expanding rapidly in the past years. For example the Pierra Menta race in France showed an increase from 75 teams in 1999 to 219 in 2016. Differentiation and increase in number of mountain sports alongside the rise in notoriety (Fig. 2) have brought more mountain sports on the verge of becoming Olympic sports. The high routes are crossed earlier and earlier (first snow falls). Ski slopes are often used by these new "adepts" for training, and because some of them doesn't know much about avalanche risks, and feel on safety. If some ski resorts set up specific paths, slopes are often used (in wrong way) without regard to safety rules, and generate animosity between local council / ski resort and adepts of this new kind of ski touring.

Communication and prevention on this new issue become a challenge.



Fig. 2: Race Tour du Rutor 2016 n. 300 teams of competitors at the start (copyright: *sci club Corrado Gex*)

It is also necessary to consider the influx of tourists in mountain communities. This influx represents an important part of mountain goers, and needs proper training, taking into account their own knowledge of mountain environments and conditions. The town of Valtournenche in the tourist area of the Matterhorn which is spread over an area of 116km² and has a resident population of 2.277 inhabitants has recorded 90.000 arrivals and over 420.000 attendances - number of nights spent by guests - in the last winter season, from December to April (RAVDA, Department of Tourism). During periods with possible critical avalanche risk, like in January 2016 (Fig. 3), it becomes essential to be able to set up an adequate, timely and effective communication to the population.



Fig. 3: Avalanche in Cervinia, 01/12/2016. "For a few minutes - he told a witness - the darkness fell throughout the area" (ANSA).

2. THE PROJECT (PRHM)

The goal of PrévRiskHauteMontagne Projet (PRHM) is to increase the resilience of the community against of emerging and specific high mountain hazards (especially avalanches, permafrost and glacial risks and dangerous weather phenomena, increasing because of ongoing climate change). Through a strong action of capitalization of the experience in over twelve years of cross-border cooperation around Mont Blanc in this field. Through an extension of the shares to other high mountain areas (Piedmont and the Valle d'Aosta, in the Matterhorn area and Monte Rosa), the project aims to:

- develop knowledge of emerging risks, particularly in the current context of climate change, through the networking of specific and scientific data;
- set up, integrate and enlarge communication tools in order strengthen risk awareness via the use of new technologies (e.g. Social networks);
- increase participation by residents and tourists (hikers or climbers) on the risks of high mountains through the development of new information and communication strategies;
- pursue action in support of data acquisition, gathering and use by the different ALCOTRA actors;
- pursuing actions of cooperation for mountain rescue professionals (e.g. "the Trilateral of mountain rescue");
- experience patterns of response to specific high mountain hazards.

3. CROSS-BORDER ACTIONS TO RAISE AWARENESS OF THE POPULATION FOR THE SAFE FREQUENTATION OF THE MOUNTAIN

The goal of this pilot activity is to inform tourists about the dangers of the high mountains (crevasse, serac or rockfalls, avalanches etc.). Group excursion, leaded by IFMGA mountain guides, to easily accessible glacial sites (Punta Helbronner on the France-Italy border, on top of the Grands Montets in Chamonix, etc.) will be organized in order to get people introduced to glacial environments and the associated risks. These glacial areas, directly accessible via lifts, are highly frequented mainly by tourists who have no or few acquaintances with the environment in which they evolve. An important number of tourists will be so sensitized during the summer 2016. The aim is to be able to extend this initiative after the end of the ALCOTRA project. The

aim is indeed to use the 2016 initiative as a startup for a larger awareness raising program targeting tourists, that will be activated from summer 2017 (Fig. 4).



Fig. 4: example of "Atelier Découverte" in the glacial area

The city of Valtournenche is organizing the "Mountain Safety Festival", in which it will present to the public, mainly tourists, topics and technical solutions related to high mountains activity.

Through Social networks we want to improve the communication mountain conditions making it timely, clear and precise, and improve the data collect strategy.

Through the organization of two conferences for local population, the role of relief agencies we want to raise awareness on the role of relief agencies and how they work in a context of public safety, land management and practice of different sports activities.

To ensure more efficient communication, in order to decrease risky situations and increase population's response capacity in the critical zone, it is necessary implement an information plan on behavioral factors under risk situations due to exceptional weather events, such as heavy snowfall in high mountain stations. Each risk will be presented as well as the safety rules for the residents or for those who are on the road. The plan designed by experts, will be The plan, designed by experts, will be the result of a "governance" action. The risk management will be shared by the main actors: the City, the Ski Resort, the consortium of tour operators, the roads management and the Autonomous Region Valle d'Aosta.

4. INITIATIVES AND INNOVATIVE KNOWLEDGE AND MANAGEMENT OF EMERGING RISKS

It becomes necessary to improve knowledge about the little-known risks (permafrost, glaciers stability), or not studied to date (snow bridges) to improve safety.

The overall objective of this activity is to improve the analysis of the risks associated with high-altitude permafrost, consolidating knowledge on its characteristics in the cooperation area, capitalizing on the results of previous initiatives and instruments (PERMAdataROC, PermaNET, RiskNat). The objective is to provide (i) the updating of the Alpine Permafrost Database (APD) in the cooperation, (ii) the application of innovative investigative techniques and (iii) the consolidation of some specific monitoring sites.

A common scientific study (a survey and a pilot site installation) is conducted on the stability of the snow bridges of crevasses, so as to understand their dynamics and dangerousness.

5. EXEMPLARY ACTIONS TO INCREASE THE RESILIENCE OF MOUNTAIN COMMUNITIES

Every year, Italian, French and Swiss rescue organizations get together to compare their methods, to share their experiences and present new gear and hardware developed in each country. This meeting is called "the Trilateral of mountain rescue". Cross-border rescue agreements allow a country to request assistance of men and/or hardware, implying that the rescuers are used to working with each other. A good cooperation and understanding between the three rescue organizations (Valais, Aosta Valley and Haute Savoie) is essential for a more effective cooperation.

Another goal is to provide the ski resorts security teams with a tool to manage, ease and structure uniformly both collected data and safety actions. This is a structured tool on multiple levels that allows data consultation for decision-making, and the inclusion of undertaken daily activities. During these phases, each activity carried out is recorded by an automatic platform log that enables the traceability of all undertaken activities.

For the next ten years, avalanche research training fields have been installed in ski areas: here people can practice for free, rapidly, and (and especially) in bad weather conditions, to improve their research skills. Furthermore teaching and learning supports are installed on site to help people during practice.

In the Mont Blanc massif there are numerous huts that welcome trekkers and mountaineers. These shelters are generally guarded during peak periods (spring, summer) in which the hut keeper welcomes and accommodates guests. When they are on site, they become sometimes an important part of the rescue chain, because they can gather information and alert with their communication means. When the shelter is closed, a portion of the hut (winter shelter) is available to the public. Some huts are also never kept, simple "bivouacs", where no service is offered. They are often located in areas where telephone coverage is limited. The objective is to install (in some huts and camps) new radio beacon, allowing mountaineers to communicate with relief efforts. If need, in the case of search for lost people, the emergency service may also call various camps to check if these people are there or if anyone may have some information. That would avoid search by helicopter.

Organization of information/training days are planned in 2017 to improve the knowledge of journalists on the mountain. *What is a serac? What different kind of avalanches...* It would allow them to inform the public with accurate and relevant information. Mountain news are, most of the time, about accident, and are commented with drama and scientific mistakes.

An effective "of community resilience policy" is built through a participatory process, in which the mountain professionals become, themselves, the first carriers to their customers of such a message. This action is centered around these professionals, involving them directly in the knowledge developed in the above actions, through a process of dissemination of scientific knowledge, as well as in specific messages for mountain safety. The main objectives of this action are: (i) raise awareness of the main categories of professionals working in the mountains with the tools and information available on the subject of risk, (ii) with the pros to learn about their needs and establish strategies shared communication, (iii) to establish the communication channels dedicated and lasting in time, making it possible to perpetuate this path of resilience. So to make this we involved in training days' huts, tour operators, professional technicians.

The project aims to standardize the high mountain access signs (safety information), very different depending of country/towns, paths, ski resort...

6. REFERENCES

- De Woul, M. and R. Hock, 2005. Static mass balance sensitivity of Arctic glaciers and ice caps using a degree-day approach. *Annals of Glaciology* 42, 217-224 pp.
- EEA, European Environment Agency (2009): Regional climate change and adaptation. The Alps facing the challenge of changing water resources. Copenhagen.
- Frey, H., Haeberli, W., Linsbauer, A., Huggel, C., Paul, F. (2010): A multi-level strategy for anticipating future glacier lake formation and associated hazard potentials. *Natural Hazards and Earth System Sciences*, 10, 339-352pp.
- Haeberli, W. Beniston, M. (1998): Climate change and its impacts on glaciers and permafrost in the Alps. *Ambio*, vol 27, 258-265 pp.
- Huggel, C., (2009): Recent extreme slope failures in glacial environments: effects of thermal perturbation, *Quaternary Sci. Rev.*, 28, 1119– 1130, doi:10.1016/j.quascirev.2008.06.007
- IPCC (2007) Synthesis Report.
- ISSW (2010) International Snow Science Workshop “A quick winter solution for hazard mitigation in the deposition area – as applied in the Aosta Valley – NW Italian Alps”.
- ISSW (2013) International Snow Science Workshop: “Avalanche crisis management, (not including outdoor activities) New practical guide to the attention of mayor and local executives”
- Krahe, P., Nilson E. (2011): Climate Projections for the Greater Alpine Region. Summary and major findings concerning the impact of Global Climate Change on regional air temperature and precipitation. http://www.adaptalp.org/index.php?option=com_content&view=article&id=388:topic-climate-projections-for-the-greater-alpine-region&catid=149:work-package-4-water-regime&Itemid=132
- Mercalli L., Acordon V., Cat Berro D., Di Napoli G. (2006): Cambiamenti climatici in Valle d'Aosta: opportunità e strategie di risposta.
- Ratto S., Cauduro M., Diotri F., Stevenin H., Torlai I.M.(2009): Rendiconto idro-meteorologico 2000-2009, 8,11,20,38 pp.
- Regione Autonoma Valle d'Aosta: Catasto Ghiacciai www.regione.vda.it/territorio/glaciers/default_i.asp
- Segor V., Burelli G., Ceaglio E., Debernardi A., Roveyaz, Pivot S.: Rendiconto nivometeorologico inverni 2008-2015. http://appweb.regione.vda.it/DBWeb/bollnivometeo/bollnivometeo.nsf/Rendiconto?OpenForm&L=_i&
- Voigt, T., Füssel, H., Gärtner-Roer, I., Huggel, C., Marty, C., Zemp, M., (2010): Impacts of climate change on snow, ice, and permafrost in Europe: Observed trends, future projections, and socioeconomic relevance. ETC/ACC Technical Paper 2010/13. European Topic Centre on Air and Climate Change (ETC/ACC), European Environment Agency (EEA).
- Zemp, M., Hoelzle, M. and Haeberli, W. (2007): Distributed modelling of the regional climatic equilibrium line altitude of glaciers in the European Alps. *Global and Planetary Change*, 56: p. 83–100.
- Zemp, M., Haeberli, W., Hoelzle, M. and Paul, F. (2006): Alpine glaciers to disappear within decades? *Geophysical Research Letters*, 33, L13504, doi:10.10