

## PRACTICAL OUTPUTS FOR AVALANCHE EXPERTS FROM TWO RESEARCH PROJECTS IN AOSTA VALLEY (NW ITALY)

B. Frigo<sup>1</sup>, M. Maggioni<sup>2</sup>, A. Debernardi<sup>3</sup>, V. Segor<sup>4</sup>, L. Pitet<sup>4</sup>, B. Chiaia<sup>1</sup>, M. Freppaz<sup>2</sup> and E. Zanini<sup>2</sup>

<sup>1</sup> Dipartimento di Ingegneria Strutturale, Edile e Geotecnica, Politecnico di Torino, Torino (TO), Italy.

<sup>2</sup> Dipartimento di Scienze Agrarie, Forestali e Alimentari and NatRisk-LNSA, University of Torino, Grugliasco (TO), Italy

<sup>3</sup> Ufficio Neve e Valanghe - Fondazione Montagna Sicura, Courmayeur (AO), Italy

<sup>4</sup> Regione Autonoma Valle d'Aosta, Quart (AO), Italy

**ABSTRACT:** In agreement with the idea of the ISSW “a merging of theory and practice”, we describe the activities carried out in Aosta Valley (NW Italy) for the formation of avalanche experts. In particular, within the Operational programme 'Italy - France (Alps - ALCOTRA)' Projects “DynAval - Dynamique des avalanches: départ et interactions écoulement/obstacles” and “RiskNat”, we organized three courses focused on the following topics : 1) artificial avalanche release, 2) snowpack slow movements and load on defense structures, 3) interaction avalanche flow / obstacles. The courses were directed mainly to avalanche experts in order, on one hand, to show them the most recent scientific findings by researchers, and, on the other hand, to give them practical information ready to be used in their expertise. On this line, we also published guide lines concerning: 1) avalanche release zone, 2) interaction avalanche flow/obstacles, 3) snowpack stability, 4) artificial avalanche release and 5) building in avalanche zones. Some of these manuals were born to fill a lack present in Italy, where, except for some rare cases, no specific law or guideline exist. They can definitely be a useful help for experts and authorities when dealing with avalanche problems. In the frame of the expert's education, web based training was born: specific on-line tutorials were ideated for the users of the new Web Avalanche Cadastre of the Regione Autonoma Valle d'Aosta.

**KEYWORDS:** Expert's education, courses, Guide Lines, web based training.

### 1. INTRODUCTION

Every topic evolves continuously, in relation for example to new technologies and legislation. Therefore the knowledge gained during university, stages or professional experiences must always be updated. Recently, in Italy, it is compulsory for experts to attend training courses, workshops, seminars, meetings, in order to be able to continue their professional activities.

When the topic is one of the less known and developed, without any clear Italian and/or international law, it is clear how the experts could stay updated only following the state of the art. Natural hazards is one of this topics, which is evolving rapidly, due to new technologies able to

solve problems inconsiderable before, and to the changing velocity of the natural environment. In this field, the experts can only follow the new findings from researchers and, on the other hand, the researchers should aim at find practical results for experts.

Therefore, a continuous and intense exchange between researchers and experts is desirable, in order to improve our management of natural hazards, such as snow avalanches.

In this work we present different activities where this exchange was possible and very fruitful.

### 2. THE PROJECTS ALCOTRA IT/FR ITALY/France (2010-2013)

The program ALCOTRA based on the transborder cooperation between Italy and France aims at improving the quality of life of populations living on transborder countries through an effective social, economic, environmental and cultural cooperation. Besides

---

*Corresponding author* : Barbara Frigo.  
Dep. of Structural, Buildings and Geotechnical Engineering –Politecnico di Torino  
Corso Duca degli Abruzzi, 24 – 10129 Torino, Italy  
E-mail: [barbara.frigo@polito.it](mailto:barbara.frigo@polito.it)

technical aspects, lots of importance is given to communication, divulgation and education. Within this operational program, the projects DynAval and RiskNat were born thanks to the willing of the Regione Autonoma Valle d'Aosta, who was the chief partner.

### 2.1 Project “DynAval - Avalanche dynamics: release and flow/obstacles interaction”

This *simple* project was born thanks to the collaboration of the Irstea (ex Cemagref) of Grenoble (F) with the aim of improving our knowledge of the physical-mechanical processes present in the avalanche release and deposition zones. In details, the attention was focus on the determination of the release volume and on the study of the interaction between an avalanche flow and obstacles of different shape and dimension.

During the project a new avalanche test site was realized in Italy: the Seehore test site at about 2500 m asl in Gressoney-La-Trinitè (AO). In France, the already existing test sites of Col du Lautaret and Taconnaz were implemented with new sensors.

The project was very practical with concrete outputs useful for experts such as the two manuals: “Manual for the study of the interaction between avalanches and obstacles” and “Manual for the identification and analysis of avalanche release zones” which will be described in section 3.2.

### 2.2 Project RiskNat – Action B3.C3 Avalanches

This project is a *strategic* project as it is strongly supported by all the political and administrative subjects involved in the natural risks prevention in mountain areas.

The action “Avalanches” had its origin in the lack of knowledge about specific topics in the frame of the avalanche science. Three different Guide Lines were written to help avalanche experts in the avalanche risk management: “Guide Lines for building in avalanche areas”, “Evaluation of snowpack stability: guide Lines for data collection and analysis” and “Artificial avalanche release: guide lines for operational procedures, methods and legislation” (see Section 3.2).

## 3. THE IDEA AT THE BASIS OF THE EDUCATION

To involve the most number of participants, we proposed different educational events in respect to the target and to the proposed topic. Two type of education was realized: *direct*, with courses, or *indirect*, through the divulgation of the manuals that summarized the results of the projects.

The languages of the education were Italian, French (official language of the projects) and English (more diffuse worldwide).

Thought frontal lectures and books are of undoubted importance and irreplaceable as means of knowledge, in the last decades the education started to be possible also at distance, via internet, therefore it is available at any times and anywhere. In this direction, we put all the lectures of the courses on the web, as well as the manuals.

We highlight the importance of the “web based training” related to the new on-line Regional Avalanche Cadastre. Special tutorials are available on-line to explain to the users how to navigate throughout this new product.

With all these activities we reached one of the main objectives of the Operational Program ALCOTRA 2007-2013: the divulgation of the specific knowledge about avalanches between the transborder countries.

### 3.1 Direct education

Within the DynAval project three training courses were planned concerning different arguments that still present some open questions in the technique and legislation behind. They were organized by the Regione Autonoma Valle d'Aosta (Assetto Idrogeologico del Bacini Montani) with the scientific supports of the Politecnico and University of Torino. The courses gave the same importance to theoretical and practical aspects.

#### 3.1.1 Artificial Avalanche Release - 2011.11.11 in Quart (AO)

The course had a duration of 8 hours and included theoretical lectures about the release process (spontaneous or artificially triggered), the failure and fracturing of the snowpack, the effect of a shock wave on the snow cover, and

also some practical examples of the different triggering methods (explosive and gas systems) and the different fields of application (ski resorts, roads and villages). The official languages of the course were Italian and English, with simultaneous translation.

The lectures are available at <http://www.risknat-alcotra.org/rna/index.cfm/eventi/dynaval-workshop-sulle-valanghe.html>.



Figure 1. Discussion time during the course “Artificial Avalanche Release”.

### 3.1.2 Slow movement of the snow and load on defense structures (2011.06.16 in Quart - AO)

Also this course lasted 8 hours and started with the basics of slow snowpack movements, with practical investigations also in forest, concluding with the presentation of real cases of snow gliding effects on rigid (cableway masts) and flexible (snow nets) structures.

The official languages of the course were Italian and English, with simultaneous translation.

The lectures are available on-line at <http://www.risknat-alcotra.org/it/index.cfm/eventi/progetto-semplice-dynaval-corso-di-formazione-snow-gliding-opere-di-protezione-attiva.html>.

### 3.1.3 Avalanche interaction with Structures (2011.12.01 in Gressoney La Trinité - AO)

This course lasted 4 hours and was in Italian and French. It was associated to the final Italian workshop of the DynAval project that was held on the 2<sup>nd</sup> of December in Gressoney-La-Trinité.

The course presented first the basics of the interaction between avalanche flows and obstacles, the design of passive avalanche protection structures and then presented the example of the Swiss Guide Lines concerning the dimensioning of avalanche tunnels and some real cases of protection of roads.

The lectures are available on-line at <http://www.risknat-alcotra.org/it/index.cfm/notizie/progetto-dynaval-dynamique-des-avalanches-depart-et-interactions-ecoulement-obstacle-pubblicate-le-presentazioni.html>.

At the end of each course, a discussion section was the most interesting moment, when the chairman V. Segor summarized the main topics of the course and all the attendants had time to ask questions and eventually present their professional experiences (Fig. 1). During this discussion, it came out clearly the necessity of filling the lack of legislation and general technical indication. The experts had the possibility of knowing the state of the art at a research level and the researches to understand which are the real needs of the experts and what they can really make following the existing legislation.

The big effort by the organizing Committee to bring scientists from all over the world in a little Region as Aosta Valley was rewarded by the success of the courses. Some numbers: 14 international speakers (5 Swiss, 5 French, 2 Italian, 1 Austrian, 1 American), 80 attendants plus the persons involved in the project.

Great interest and participations were characterizing other events, such as the technical project meetings, the visits to the different avalanche test sites and the final workshop to divulgate the project results (on 2<sup>nd</sup> December 2011 in Gressoney-La-Trinité (AO), Italy, and on 26<sup>th</sup> March 2012 in Chamonix, France).

Of a different kind, however very important, was the information and divulgation at a more international level, with oral presentations and posters at about 15 international scientific congresses

### 3.2 Indirect education

Within the two projects, the project chief, Regione Autonoma Valle d’Aosta (Assetto Idrogeologico del Bacini Montani) with the scientific supports of the Politecnico and University of Torino and the fundamental collaboration with the Irstea (ex Cemagref) French scientific partner of the projects, realized five manuals on different topics:

1. Manual for the study of the interaction between avalanches and obstacles;

2. Manual for the identification and analysis of avalanche release zones;
3. Guide Lines for building in avalanche areas;
4. Evaluation of snowpack stability: guide lines for data collection and analysis;
5. Artificial avalanche release: guide lines for operational procedures, methods and legislation.

The first two were written in Italian and French within the DynAval project and are more scientific, also with theoretical chapters, while the second three are very practical, developed within the project RiskNat (available only in Italian).

The “Manual for the study of the interaction between avalanches and obstacles” describes how to realize an experimental avalanche test site at real scale, starting from its conception to its managements. It also presents the dimensioning of passive protection structures, with real cases of catching dams in France and Italy.

Thought with theoretical chapters about the release process, the “Manual for the identification and analysis of avalanche release zones” gives useful information about the identification of the avalanche release area, the relationship between new snow amount and release probability of a slab avalanche.

The “Guide Lines for building in avalanche areas” started with a wide analysis of the architectonics of buildings in avalanche areas throughout the Alps, giving then practical engineering rules in order to build them in a proper way to resist to the avalanche impact. It gives information about how to dimension also the secondary structural elements, such as chimneys, balconies, windows, which are at present considered as vulnerable elements.

Finally it contains a useful vademecum to correctly realize an expertise about the interaction between avalanches and buildings.

The manual “Evaluation of snowpack stability: guide lines for data collection and analysis” was born in order to produce a document collecting all the different methods used by experts to evaluate the snowpack stability. It collect all the existing literature and, for ex., gives information about the best choice of the correct place to realize stability tests, about how to interpret them in the frame of the avalanche hazard assessment.

The manual “Artificial avalanche release: guide lines for operational procedures, methods and legislation” (Fig. 2) presents the state of the art concerning the triggering methods used in Italy, France and Switzerland, as well as the existing legislation about this topics. It suggests then an operational plan to realize artificial avalanche triggering for protection of ski runs or roads.



Figure 2. Front page of the manual “Artificial avalanche release: guide lines for operational procedures, methods and legislation”.

The manuals were presented and given to the public on 2012/05/28 in Aosta (IT) during a divulgation event of the project RiskNat. They are available on-line at <http://www.risknat-alcotra.org/>.

### 3.3 The web based training for the new Regional Avalanche Cadastre

After two year of an intense collaboration between the Avalanche Warning Service of the Regione Autonoma Valle d’Aosta and the informatic Company IN.VA (Aosta), the new digital Regional Avalanche Cadastre was born on-line (<http://catastovalanghe.partout.it/>)

based on a GIS (Fig. 3). The aim was to allow the users to obtain information of the historical avalanches (back to 1970) in a clear and easy way: date of the events, outline, photographs and technical data are available.

The on-line page is divided in three sections, according to the different type of interested user: 1) a free section for all users; 2) a technical section for avalanche experts and researchers; 3) a more detailed technical section for members of Avalanche Commission and Public Administrations.

To help the users in the navigation, two tutorial videos of 5 minutes were realized and available on-line.

#### 4. CONCLUSIONS

The aim of the projects to produce very practical outputs useful for avalanche experts were obtained also with the educational activities presented in this work.

During the two projects DynAval and RiskNat, researchers and experts had different possibilities to share their knowledge with the common aim of improving our managements of avalanche risk.

#### 5. ACKNOWLEDGEMENTS

This work was possible thanks to the Operational programme 'Italy - France (Alps - ALCOTRA)' Project "DynAval - Dynamique des avalanches: départ et interactions écoulement/obstacles" and "RiskNat". Therefore, all was possible only thanks to all the persons involved in these projects: Monica Barbero, Antoine Brulport, Enrico Bruno, Eloïse Bovet, Mauro Borri Brunetto, Fabrizio Barpi, Elisabetta Ceaglio, Bernardino Chiaia, Valerio De Biagi, Danilo Godone, Oronzo Pallara, Davide Viglietti and the staff of Avalanche Warning Service of Aosta Valley.

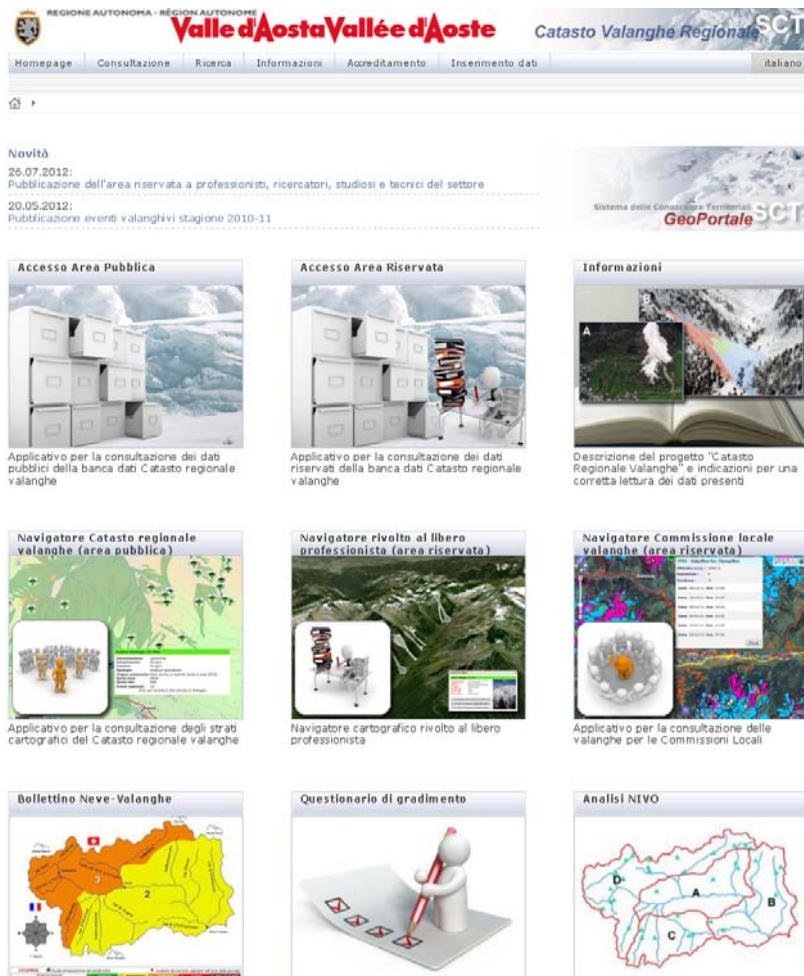


Figure 3. First page of the new on-line Regional Avalanche Cadastre.