

RiskNat: a cross-border European project taking into account permafrost-related hazards

The *RiskNat* B1-C1 team

1 THE PROJECT *RISK*NAT

1.1 Introduction

In mountain areas natural hazards and management risks related to permafrost degradation are still poorly known and considered.

Alpine permafrost is rather different from permafrost in arctic or northern lands. Thermal regime largely depends on microclimate effects, dealing with altitude, aspect and geographic position; moreover, thermal regime inside of materials depends on material type itself (rock, debris, soil), slope steepness, exposure to solar radiation, water circulation and presence of snow. Because of the complexity of these parameters, permafrost distribution is discontinuous and difficult to detect. Furthermore, alpine permafrost affects areas traditionally characterized by few inhabitants and infrastructures. Thus, until now there has been no need of a good understanding of alpine permafrost-related phenomena from a practical point of view.

In the recent past, changes of climate are leading to permafrost degradation and to an increase in dynamics such as rockfalls in high elevation areas. The effects of these slope instabilities can expand downward to valley floors and populated areas (e.g. debris remobilized by debris flow). On the other hand, high elevation zones get more and more interested by human activities and structures (mainly for tourist trade).

That's why not only the scientific community but also public administrations involved in land use planning, in civil protection and in risk management had increased their interest to permafrost-related phenomena, becoming more important as strictly related to climate change. *RiskNat* project is an example of this increasing response to new needs.

1.2 *RiskNat* project

RiskNat is a cross-border project in the framework of the program Alcotra France-Italy (2007-2013), developed between 2009 and 2012. It focuses on natural hazards that concern mountain areas: earthquakes, landslides, torrent floods, snow avalanches and hazards related to permafrost degradation. All regions of Italy, France and Switzerland in the western Alps are involved.

RiskNat aims at the constitution of an interregional platform on natural hazards by means of (i) knowledge and experience exchange between

technicians, researchers and public administrations of the different regions and (ii) awareness programs about natural risks.

2 ACTIVITIES B1- C1: HAZARDS DERIVING FROM HIGH MOUNTAIN ENVIRONMENT EVOLUTION

2.1 Objectives

Activities B1 and C1 (*Hazards deriving from high mountain environment evolution*) focus on permafrost. Regions involved are: Autonomous Region of Aosta Valley (IT), Piedmont Region (IT), Department of Haute-Savoie (FR), Wallis Canton (CH). The aim is to define tools and procedures for (i) the assessment of hazards related to permafrost evolution in high mountain areas and (ii) the management of the risks resulting from its interaction with infrastructures located in permafrost areas. The understanding of the phenomenon is very complex and needs to be based on the knowledge of (i) meteorological conditions at high resolution, (ii) propagation mode of external thermal state inside the lithological materials and (iii) changes in geotechnical and mechanical parameters with temperature.

2.2 Methods

A first step is to define common criteria to assess permafrost distribution and to make thematic maps using both empirical and physically-based models.

Secondly, scenarios for permafrost evolution and related effects on natural hazards in response to climate change should be studied. These require to know: (i) how permafrost state of material reacts to increasing air temperature (by modelling); (ii) how mechanical characteristics of material (rock, debris) change with temperature rising (by laboratory tests); (iii) which are the effects on natural hazards like landslides and debris flows. In addition, the project analyses also interactions with human activities (infrastructures and inhabited areas) to define constraints and criteria for building in high mountain areas with definition of priorities for protection measures.

To test monitoring techniques and to improve the knowledge in permafrost-related risk management, several case studies have been chosen in Aosta Valley and Wallis.