ABSTRACT

THE 2012-2013 WINTER SEASON

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The 2012- 2013 winter season was characterized by heavy snowfalls on most of the Italian Alps. Winter snowfalls were then followed by further snowfalls in late spring-early summer, which lengthened the season even further.

Temperatures in winter were in the average range, although some particularly cold periods were also recorded.

Winds were intense for many periods, leading to major snowdrifts and resulting greater avalanche danger. The avalanche hazard degree mostly used was moderate (level 2), but very long periods were also characterized by considerable avalanche danger (level 3).

Some eighty avalanche accidents were recorded with 27 fatalities.

The most intense avalanche periods were in March and mainly in April, following snowcover melting.

CRITICAL ANALYSIS OF A REGIONAL APPROACH TO THE STUDY OF SNOW CONDITIONS: THE FRIULIAN CASE

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Not too long ago, the authors of this report carried out a study of snow conditions in the Friulian Alps and Prealps, based on the data collected from 43 manual snow and weather monitoring stations belonging to the regional network. The study dealt with the statistical analysis of two very important snow variables in relation with both the designing of avalanche barriers and the simulation of avalanche dynamics for the mapping of areas subject to avalanche risk: snowcover height (Hs) and snowcover height increase after three consecutive days of precipitation (DH3gg). The analysis, carried out using regionalization methods, allowed the authors to estimate the values of these variables for prearranged geographical area, altitude and return times.

Recently, following the expansion of available databases, the original study was updated, which provided a useful opportunity for a first critical analysis of the results that can be obtained by means of a "regional" approach to the analysis of snow condition data.

It was therefore possible to underline that statistical analyses of snowfall figures carried out with regionalization methods can provide estimates of quantiles of the variables considered with a much higher degree of accuracy compared with that that can be achieved using the most common point estimations usually implemented in engineering practices.

GRAIN DISTRIBUTION ANALYSES IN AVALANCHE SNOW DEPOSITS: SURVEY METHODS AND FRACTAL ANALYSIS

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Scale invariant phenomena are common in nature and fractals are the most suitable mathematical tool to describe them.

Snow avalanche flow is made of a mixture of grains and aggregates (granules) which can be broken or sintered together. Knowing granular interactions is important to understand how avalanche flows. In this paper, a fractal model for describing grain size distribution in the avalanche snow deposits is formulated by introducing the concept of aggregation probability.

Thanks to a special survey of the grain on the deposit surface, it is possible to verify that the model is able to highlight the action of sieving performed by avalanche during its dynamical motion.

ANALYSIS OF THE FACTORS LEADING TO SNOW GLIDING: THE Mont de La Saxe (AOSTA) CASE STUDY

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In the last few years, many progresses have been made to manage to understand glide avalanches; however the processes leading to this kind of phenomena are still poorly understood and therefore they represent a major point of uncertainty for avalanche forecasting.

In this study, we aimed to contribute to the snow gliding understanding, with particular attention to meteorological, snow and soil predisposing factors. A monitoring site was settled in the NW Italian Alps, on a west exposed avalanche release area.

It is usually characterized by intense snow gliding, resulting in big glide cracks, often leading to the release of a full-depth avalanche.

Two plots were chosen and equipped with snow glide shoes, one close to a water source and the other in a dryer zone.

Temperature and water content sensors were located at different depths in soil and snow.

Meteorological data were recorded by a nearby automatic weather station; snowpack properties were evaluated by manual snow profiles; additionally, soils were characterized focusing on the physical properties of the upper horizons.

Figures were gathered in two hydrological years, 2009-2010 and 2010-2011, characterized by different meteorological conditions: colder and snowy the former, warmer and less snowy the latter. Snow gliding was recorded both in the dry and in the wetter sites, with comparable rates (3.5 cm/day in the dry area - 4.4 cm/day in the wet area) during the first winter season, but about one month earlier in the wetter plot.

The significant increase of snow gliding rate before snow avalanche release in 2010 confirmed its importance as a useful predictor variable for the triggering of a glide-snow avalanche. During the second winter season, snow gliding

rate was significantly greater in the wetter site (6.3 cm/day vs. 0.6 cm/day). Results highlighted the relationships between gliding process and soil conditions (water content, temperature) which were identified as the main environmental factors controlling the development of snow gliding, both in the dry and the wetter plots. Moreover, the liquefaction of soil has been identified as a potential factor contributing to the snow gliding processes, but this is an issue needing further investigations. Among the meteorological factors, snow depth has shown a significant relationship with the movement of the whole snowpack. Taken together, the results provided in this study showed how the glide process can be modelled with a set of predisposing factors for soil and snow, but the results appeared site-specific and can thus be applied to other places with due caution.

NEW APPLICATION FOR RAPID MEASUREMENT OF AVALANCHE LIMITS: PROCEDURE AND FIRST VALIDATION

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In the framework of the "Monitoring for the Avalanche Prevision, Prediction and Protection" – MAP3 project – P.O. Cooperazione territoriale europea Italia/Francia (Alpi) 2007-2013 – a new 3D mapping tool is under development to rapidly take the avalanche census and implement the regional Cadastre. This method was born to support Forecasters and Hazard Cartographers for the rapid measurement and drawing of avalanche limits, especially on the deposition zone. The tool manages either a single or a sequence of digital photographs (taken with a calibrated camera also from helicopter) of the avalanche event – take integrated with a digital terrain model and regional orthophotomaps creating a "solid" image geo-referenced with only a few recognized points and shown in 3D-GIS environment. The developed methodology allow experts to map the corrected perimeter of the avalanche according to the morphology of the avalanche basin. Moreover the operator can take some measurements such as avalanche surface, release areas, distances from strategic points (roads, buildings, cableways, etc…). This automatic procedure will have a processing time for each avalanche event surveyed. The output of the tool will be the perimeter of the avalanche in a shape file format linked to an additional information table. To validate the methodology, three regional avalanche test sites are taken into account: P.ta Seehore in Gressoney-La-Trinité (experimental test site of Aosta Valley to study small/medium avalanche dynamics), Menthieu in Valgrisenche and Crammont in Pré Saint Didier. For each avalanche basin, different methods of perimeter surveys were adopted (laser scanner, GPS, etc …) in order to properly assess the accuracy, advantages and limitations of the tool developed and calibrate it.

The goal is to quickly take a survey and mapping the perimeter of avalanche events to have the update of regional Cadastre and hazard maps in Aosta Valley in almost real time.