“Risk, Research and Innovation” project on wet-snow and glide-snow avalanches in Aosta Valley (NW Italian Alps): the experimental approach

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THE PROJECT AND ITS OBJECTIVES

Mountain Risk Research Team - **MRR Team** (established in the framework of the "Call for the creation and development of Research Units" - DGR n. 1988 dated 26/08/2011) → a multidisciplinary research unit in the field of mountain natural hazards that includes universities, research institutes and a ski enterprise of Aosta Valley and develops the Operational Project “RRI - Risk, Research and Innovation“ with these scientific and technological objectives:

(1) to develop tools for monitoring and prediction of wet-snow, glide-snow avalanches, identifying driving factors and possible thresholds;
(2) to introduce new techniques for the artificial triggering of wet-snow avalanches as a management tool to support Monterosa Ski technicians in the Plan of Actions for the Artificial Avalanche Triggering (PIDAV).

DESCRIPTION OF THE EXPERIMENTAL SITES

Skirama of the Monterosa Ski resort and localization of the test sites (red circles)

4 experimental test sites, focused to improve knowledge on snow humidification and glide-snow and wet-snow avalanches mechanisms, have been installed during Summer 2013 within the Monterosa Ski resort, at the head of the Lys and Ayas Valleys, on the Monte Rosa Massif (Aosta Valley, North-western Italian Alps).

1) “Pista Nera” (Gressoney-La-Trinité, 2230 m asl, ESE, 40°) located upstream of the "Pista Nera” ski slope

2) “Sant'Anna I” (Gressoney-La-Trinité, 2120 m asl, E, 36°) placed downstream of the cable car arrival to Sant'Anna

→ test sites, located in glide-snow avalanche release areas, to monitor the gliding process and to study its most important driving factors.

The devices include two glide-snow shoes for each site, temperature and water content sensors in the soil (at different depths: 5-15 cm) and in the basal snowpack layer.

All sensors are connected through buried cables to data-loggers located in safe positions outside the release area.

A web-cam (Courtesy of Consorzio Turistico Gressoney Monte Rosa) is continuously monitoring the site 1) “Pista Nera”.

3) “Sant'Anna II” (Gressoney-La-Trinité, 2170 m asl, 360°), near the cable car arrival to Sant'Anna → experimental site, located in a flat area, to test electromagnetic sensors (eg. WCR - Water Content Reflectometer) for snow density and water content measure, important key variables for snow-gliding phenomena.

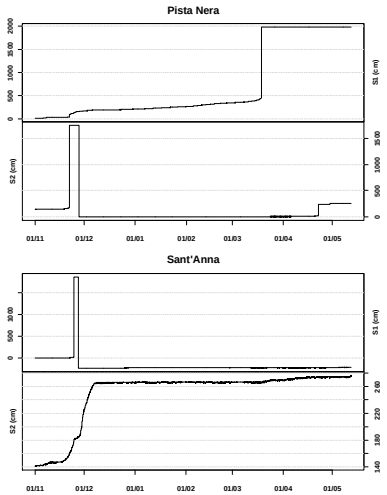
4) “Pista Larici” (Ayas, 2100 meters asl, WNW, 30°), wet-snow avalanche area above the “Pista Larici” ski slope → experimental site to test the effectiveness of different protection actions, such as for examples innovative wood defense structures, artificial release measures, with respect to the risk related to wet-snow avalanches.

Sensors for humidity and temperature (*iButton*®) at the snow/soil interface and in the soil are herein installed.

Snowpack characterization are associated to the water content measures using a portable reflectometer (CS616 sensor) and performed weekly in **3) “Sant'Anna II”** (daily and weekly snow study plots of the Avalanche Warning Service - MOD1 and MOD4 AINEVA) and in **4) “Pista Larici”**

PRELIMINARY RESULTS

At the end of the winter 2013-2014 in the sites **1) “Pista Nera”** and **2) “Sant'Anna I”**, three glide-snow avalanche events have been observed and successfully recorded by the snow gliding shoes and by the data-loggers.



Gliding movements (cm, cumulated) registered in the sites “Pista Nera” and “Sant’Anna I” during the winter season 2013-2014 by the glide snow shoes (S1 and S2).

The first two events occurred late in Autumn, after the intense snowfalls registered between 19 and 22 November that brought more than 1 m of new snow in the area.

The *first* avalanche occurred at 11.06 p.m. of 21 November in the **“Pista Nera”** site during the apex of the snowfall.

The *second* event occurred in the **“Sant’Anna I”** site, at 6.35 p.m. of 24 November, after the first sunny and warm day once the snowfall was over.

The *third* event occurred on 18 March at 2.00 pm in the **“Pista Nera”** site after a prolonged time period of good weather (absence of snowfalls since 5 March), rise in temperature and snowpack settlement.

In the Pista Nera site, besides the registered event in March, between 16 and 18, other three glide-snow events occurred, but were detected only by the web-cam as they didn’t involve the glide-shoes

In the test sites **3) “Sant’Anna II”** and **4) “Pista Larici”**, in order to validate the sensor systems, a first calibration curve to adapt CS616 water content reflectometer to estimate snow density and water content has been implemented and it is now in a testing phase.

Finally, many artificial avalanche releases were carried out in the site **4) “Pista Larici”**, also trying innovative methods still in a testing phase, but without any avalanche release.

DISCUSSION AND CONCLUSIONS

The Operational Project “RRI-Risk, Research and Innovation" of the Mountain Risk Research Team shows how the development of new strategies in the mitigation of risk due to wet-snow and glide-snow avalanches cannot avoid a multidisciplinary approach and a strict cooperation between researchers, technicians and operators of the ski-resort areas.

Analyses of the data collected during the past winter are now in progress, with the aim of finding threshold values for the driving factors of such phenomena and therefore to provide a valuable early-warning tool to the security personnel of Monterosa Ski for the management of the ski slopes. New data collection will be carried on and implemented during the upcoming winter season 2014-2015.