ABSTRACT

SNOWCOVERS IN NY-ÅLESUND (BRØGGERHALVØYA - SVALBARD ISLANDS)

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In the 1998-2015 period, over 190 snowcover profiles were carried out in the Ny-Ålesund area (Brøggerhalvøya - Svalbard Islands) in the framework of the Italian CNR research activity at the scientific base of Ny-Ålesund - Dirigibile Italia. The measurements were carried out and stored according to international standards. The analysis of more than 1,600 snow layers allowed researchers to determine some crystallographic characteristics of grains for the Arctic zone: prevalent forms, average size, hardness and density. The first results show, for the Brøggerhalvøya snowcovers, the prevalence of faceted crystals FC, depth hoar DH and transitional forms RGxf and FCxr. Many rounded grains RG, due to the action of wind, were also observed. The average seasonal snow density, determined for the end of the accumulation season, amounts to 311±86 kg m^{-3}, and to 385±60 kg m^{-3} for the multiannual snow, for a general average value of 346±45 kg m^{-3}. Snowcover duration in the area along the coast is 7-8 months and snowcover height is generally lower than 100 cm.

The stratigraphic sequence show the presence of basal layers FC and DH and thin superimposed layers of IC and MF which, alongside the general snowcover features (duration and thickness) and the meteorological features of the area, confirm the climate classification as "High Arctic maritime snow climate" for the western snowcovers of Svalbard islands.

INFLUENCE OF SNOWCOVER ON GROUND SURFACE TEMPERATURE

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The surface thermal regime is a parameter correlated with soil physical conditions.

During winter the snowpack has an insulating effect between atmosphere and soil. In fact, its efficiency in that sense depends upon several climatic (precipitations amount, air temperature, wind) and topographic factors (altitude, exposure, slope). This paper presents the analysis of four years of hourly measurements of ground surface temperature in 20 different points distributed in Cervinia basin, Valtournenche (Aosta).

The points are located at different altitudes, exposures and slopes with the aim of investigating relationships between air temperature, topography and snow cover spatial and temporal distribution. During the four years (2010-2014) taken into exam, the snow cover has shown considerable variability, allowing researchers to obtain a good representation of possible conditions. We conclude that ground surface temperature is closely related to the snow cover duration and its melting rate. Furthermore, besides altitude, exposure is the factor exerting the greatest influence on snow cover

duration. This analysis has also revealed the possible presence of permafrost at the coldest points above 2,500 a.s.l.

EURACSnow Maps Automatic monitoring of snowcover in the Alpine range with MODIS satellite images

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This paper presents the results of an innovative algorithm, EURACSnow for snow cover monitoring based on MODIS satellite images. In the proposed approach, the main goal is to maintain resolution as high as possible, thus exploiting the 250 m resolution bands of MODIS. Having snow maps at 250 m notably improves snow investigation, especially in mountainous areas characterized by extreme landscape variability. By using this algorithm, daily snow cover maps have been generated over the Alpine range and for the period from 2002 to 2015. To better understand and analyze the snow inter-annual variability, specific products have been generated for each year, such as snow cover duration, the first day and the last day of snow.

THE PREVENTIVE AVALANCHE RELEASE SYSTEM IN THE PADON-MARMOLADA SKI AREA

M. Martinelli

The Padon – Marmolada ski area in the Rocca Pietore resort (Belluno), on the Veneto side of Passo Fedaia at the foot of Punta Serauta (3,069 m a.s.l.) in the Marmolada range, during winter 2013/14 was heavily affected by the release of large avalanches that damaged two cableway systems and an alpine hut, even reaching Padon and Variante Fedaia ski runs, as well as provincial road 641 of Passo Fedaia. The damage made to skiing infrastructures led to the immediate closure of the Sella Ronda circuit towards the Marmolada area and resulting stop of any tourist activity in the area. Following this event, Padon Marmolada S.p.A. immediately undertook to repair damaged installations and restore safety in dangerous areas, working side by side with Rocca Pietore municipality, also considering exceptional events like the one previously mentioned. This article illustrates the artificial avalanche release system developed to ensure safety in the area, which includes a range of O'bellx® compact avalanche-release systems installed in those areas subject to avalanche release. The system, which was completed and tested already in December 2014, has restored safety conditions in a very short time after the events, making ski infrastructures fit for use in safe conditions.

FROM AVALANCHE HAZARD TO AVALANCHE RISK: A METHOD FOR THE EVALUATION OF VULNERABILITY AND THE LOMBARD CONTINUOUS MATRIX

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Objective: determination of an operational approach for the synoptic evaluation of the avalanche risk in the Lombard Alpine and Prealpine areas and its integration into the Regional Civil Protection alerting system.

Method: The first analysis aimed to identify the different territorial avalanche vulnerability factors, as inferred from: topographical data (slope, altitude, curvature, exposure), land use and vegetation cover data, existing maps of probable localization of avalanches (*CLPV*), historical events and analyses on the exposed elements (infrastructures and residential areas). These factors are the basis for the determination of a vulnerability function, assumed logarithmic. This function processes a weighted sum of individual vulnerability factors and returns three continuous values of Vulnerability (from 0 to 4) for each municipality. The three values are respectively representative of: the potential surfaces of avalanche detachment (*V_DIST*), the potential sliding surfaces (*V_SCIV*) and the local presence of exposed elements (*V_ESP*). The combination of the three values has led to the determination of a global vulnerability (*V_TOT*) for each municipality. The avalanche risk calculation considers the obtained total vulnerability and the hazard, forecasted by ARPA Lombardia-NivoMeteo Centre and Meteomont-CFS. The risk calculation was not carried out using a traditional risk matrix (with a limited number of inputs and outputs), but using a continuous matrix, that allows to choose the precision of hazard, vulnerability and risk values. This matrix, defined "LOMBARD CONTINUOUS MATRIX for the evaluation of the avalanche risk", is graphically displayed as a bundle of curves, within the two-dimensional hazard-risk plane, parameterized on the vulnerability values (each associated with each municipality).

Results: The obtained risk varies continuously between 0 and 1, on a scale of five intervals corresponding to grey, green, yellow, orange and red levels (*absent*, *negligible*, *regular*, *moderate*, and *high risk*). It can be mapped on municipality scale and later aggregated to homogeneous area scale, territorial unity of warning. Finally one additional analysis tool allows to focus the alert using a number of changing factors (exposure, altitude), evaluated daily by the hazard forecasting centers. This new analysis allows to reduce the number of false alarms during the winter seasons.

Conclusions: The Functional Centre processes the results of the analysis on the homogeneous area scale and proceeds with the release of a Regional Alerting document (*Avviso di Criticità regionale*) for the Civil Protection system. It must be remembered that the message of this document must be completed only through the local evaluation, based on detailed and site-specific analysis. The proposed methodology is now under validation and it will be improved in the next future.