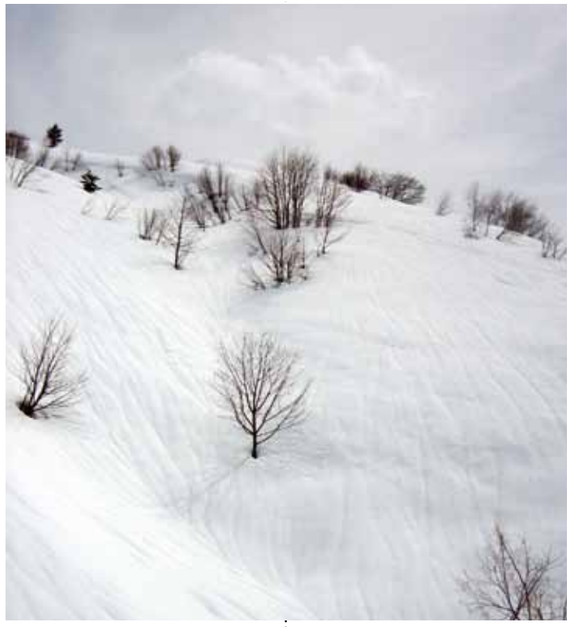
ABSTRACT



SNOWFALLS IN THE PIEDMONTESE ALPS IN THE LAST FIFTEEN YEARS
Favourable conditions for skiing and artificial snow production

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The International scientific community, supported by meteorological measures, documents a phase of global warming whose responsibility is attributed to human activity.
Such theory is confirmed by the 4th report of IPCC (Intergovernmental Panel on Climate Change), published in spring 2007, which constitutes at the moment the most complete, up-to-date and reliable well-run source on the topic of climatic change.
The effect of such warming, over the whole planet, is the reduction of snowfall, in terms of snowfall quantity, but also of thickness and duration of the snow cover.
This analysis has the goal to supply a study about the snowfall in Piedmont during the last fifteen years.
We have considered the data referred to the winter period, between December and March, which is the most meaningful for the evaluation of the snow cover in order to practice ski activities. We have subdivided the regional Alpine chain into four different areas (North, North-West, West and South), which are homogeneous from a geographic and climatic point of view.

THE "*STICKY SNOW*" PHENOMENON OBSERVED IN THE ITALIAN WESTERN ALPS DURING SPRING 2009
Preliminary results obtained by a team of university and CNR researchers

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The Alpine seasonal snowpack accumulates wet and dry atmospheric deposition which may be held in storage until release during the melting period. This may have potential effects on soil and water quality. The monitoring of chemical properties of the snowpack is therefore essential in order to assess the environmental quality of the mountain regions. In particular, the Alps are a valuable observation point for anthropogenic emissions as they are located in one of the most industrialized regions of the world.
During spring 2009 several ski mountaineers practicing in the Western Italian Alps found a sticky material under their skis and sealskins. In May 2009 more than 30 reports were filed for occurrences spread over the Western Italian Alps at elevations ranging from 1,500 to 2,700 m asl.
Samples of the sticky material were collected from the skins and skis while snow was also sampled from the surface and internal layers of five areas affected by this phenomenon.
The samples of sticky material and snow were analyzed for total and organic carbon, total nitrogen, heavy metals and other trace elements, and organic constituents including polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbons. Snow samples were also analyzed for pH, conductivity and ion concentrations. Pollen analysis was carried out in selected snow samples.
The solid material collected from the skis had a brown-black, sticky appearance with a sharp smell of hydrocarbons. The total carbon fraction ranged from 35 to 65% and a relatively large amount of long-chain aliphatic hydrocarbons (20<C<30) and polycyclic aromatic hydrocarbons were found in all the samples. FT-IR spectra evidenced the presence of long-chain alkyl compounds. Some heavy metals such as Zn, Cu, Mo, Cd, Sb, Pb and Bi, presented a moderate enrichment with respect to crustal average concentration. According to recent scientific literature, the chemical characteristics of this material suggest a predominance of combustion-derived residues (ashes, soot).
The snow samples collected from the upper snowpack layers revealed the presence of a relatively high quantity of arboreal pollen grains (13 pollen types), mainly belonging to Larix decidua, Fagus sylvatica and Pinus sp., related to the elevation and the location of the sampling sites. The pollen analyses revealed a local deposition of grains and an upward transport mainly due to nearby wood pollen production.
Moreover the superficial snow samples generally showed an important content of dissolved organic carbon (DOC), much higher than those observed in Turin urban snow and in Eastern Alps collected in winter 2009. In our snow samples dust concentrations were exceptionally high with the presence of big dark aggregates. The solid material was collected by filtration and analyzed for organics as the previous samples. The organic profiles were comparable with those obtained for the sticky material, with high levels of heavy hydrocarbons and PAHs.
The concentrations of the inorganic components showed an irrelevant contribution from natural strong events such as Saharan depositions. The content of DOC, solid material and organics in the internal snowpack layers were comparable to the literature data for Alpine fresh snow highlighting that contamination was limited to the superficial layer.
From these findings we can conclude that the material accumulated under the skis and seal skins was comparable to that found on the surface snow layers and its chemical characteristics suggested a pyrogenic hydrocarbon origin. While the chemical nature of the sticky material was well characterised, its source and provenience have not been clarified yet, as its fate in the soil-water system.

CONTRIBUTION TO THE STUDY OF CLIMATE CHANGES IN THE ITALIAN WESTERN ALPS: THE VAL MAIRA CASE

S. Fratianni, S. Brunatti, F. Acquaotta and with collaboration of M. Cordola

The choice on the Maira valley is due to the availability of climatic daily data from 1923, never digitized, for two meteorological stations: Acceglio Saretto (1,530 m) and Combamala (915 m). We considered the data of snow depth, fresh snow depth, precipitation and temperatures registered by ENEL (National Graft for the Electric Energy) and at the time of property of ARPA Piemonte.
The analysis of historical series leads during November and April, supplied the main climatic trends and to better understand the entity of the change, we calculated the climatic index on the considered period and over the thirty-year period WMO (1971-2000).

THE SNOWRKNOWN PROJECT
Innovative methods for SWE calculation at the basin scale

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"SnowRKnown" project (supported by Fondazione CRT) investigates the Snow Water Equivalent (SWE) at the basin scale with innovative devices. The estimation of the SWE, the product between the height of the snow cover and the ratio between snow and water densities, is usually based on punctual measures with traditional techniques (manual excavation of snow trenches with the survey of vertical density profiles). These techniques are time consuming and require a large employment of human resources when applied to alpine basins of several square kilometres area. Instead, the project verified the use of electromagnetic devices, the Ground Penetrating Radar (GPR), the Time Domain Reflectometry (TDR) and Water Content Reflectometry (WCR) for the faster estimation of the desired snow properties.
Two campaigns have been performed to a portion of the Breuil basin (Valtournenche, Aosta Valley -Italy) during April 2008 and April 2009.

ZONING OF AVALANCHE AREAS BASED ON AVALANCHE RELEASE LIABILITY
A methodological and operational proposal following a five-year period of observations and snow surveys in the Prati di Tivo area

M. Pecci and P. D'Aquila

The paper presents the results concerning GIS environment modelling and elaboration of surveyed geomorphologic and snow data with the aim of contributing to the zoning of snow avalanche susceptibility.
The research activities have been performed in the Prati di Tivo ski area (Gran Sasso d'Italia Mountain range - Abruzzo Region, Teramo District) and have contributed to the drawing up of a predictive model, able to elaborate data in distinct and subsequent steps, aimed at producing avalanches zoning maps.
Afterwards, the model has been validated in other and different areas and can be implemented also with respect to other snow-meteorological parameters (thickness of recent snowfalls, wind transported snow, thermal rise, etc.), local geomorphologic features (rock type, attitude and roughness of the bedrock, stability, etc.) and vegetation (type, density, etc.).
The model is easily updatable in "real time", thanks to a toolset, ad hoc developed in GIS environment and, in perspective, is able to provide a "full" contribution in forecasting terms.

DRAINAGE OF AN ALPINE GLACIER
Study of the drainage system of an alpine glacier through the GEOtop distributed hydrologic model and a linear reservoir runoff model

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Glaciers play a fundamental role for alpine areas. In addition to feeding mountain fauna and flora, water from glacier melting also fosters agriculture development in the valley bottom. In this context, knowing more exhaustively the glacier hydrological system evolution would mean being able to understand the time and ways through which glacier melting makes water available to the valley bottom, mainly in the light of climate changes underway. The civil engineering department of the Trento University, along with the SAT Glaciological Committee and Museo Tridentino di Scienze Naturali, has been involved since 2004 in the "Experimental study and monitoring of alpine glaciers project", aimed at measuring and simulating the long-term hydrological cycle of Trentino glaciers.
The aim of this contribution, based on the degree thesis of engineer Ivan Noldin, is to simulate the space-time dynamics of the Mandron glacier (Adamello-Presanella range) by combining a distributed hydrological model and a linear reservoir runoff model. All that allows for the calculation of flows downstream to the glacier based on the actual thermal balance and the evolution of the snow-covered glacier surface.