



## **Avalanche danger scale validation: analysis of data from MeteoTrentino**

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In the last ten years, the average annual number of avalanche casualties has been constantly diminishing, thanks mainly to the improvement of rescue methods and self-rescue. However, an increase in the number of accidents was observed (Valt 2009), and that despite the greater amount of information available to mountain hikers and generally improved knowledge of avalanche phenomena. Therefore the problem arises to understand why, despite all the instruments currently available, accidents keep rising, and how the various bodies in charge can intervene to solve the problem. An interesting aspect to be verified is that of the reliability of the avalanche danger scale diffused by snow and weather stations in determining the likelihood of skitourists triggering an avalanche. In the second place, it is no less important to be

able to gather information about the behaviour of hikers according to the hazard degree issued. The danger scale local snow and weather stations issue several times a week is an essential element - though not exclusive - available to mountaineers for planning their trips. The danger scale sums up in a five-degree scale the great amount of information stations gather about mountain conditions and weather, and their recent evolution, implicitly assigning a weight to each of the factors considered.

## **N.A.T.L.E.F.S. An effective collaboration between the avalanche warning service of the autonomous province of Bolzano and the Alpine guide association of Alto Adige**

*F. Gheser*

N.A.T.L.E.F.S. is a project resulting from collaboration between the avalanche warning service of the autonomous province

of Bolzano and the Alpine guide association of Alto Adige. This was made possible thanks to active collaboration from Alpine guides, creating a sort of itinerant monitoring and observation network. The particular thing is that Alpine guides offer their contribution while making their work, that is, whenever they accompany clients in winter trips. There are seven remarks, like the letters that make up the acronym NATLEFS. These are in fact the initials of seven words in German language that indicate parameters that are as easily measurable when hiking as they are important for the avalanche prevention service. Such information complete the framework of data available to the avalanche warning service for the assessment of snowcover stability and the issue of avalanche bulletins. Remarks are then transmitted via SMS to a dedicated server whose task is to manage messages according to the various procedures that follow reception. Though being still in its embryonic stage and used for the first time in a whole win-

ter season, the project has however proved to have excellent basic features and good management flexibility, allowing for it to be further modified in future based on experiences.

## **Avalanche accidents: slopes and typical snow layers, times for finding buried people**

*M. Valt*

In Italy figures on avalanche accidents are gathered by several rescue and prevention organisations. The most exhaustive databank is that provided by AINEVA, which gathers all data from avalanche accidents considered from 1984 to 2011. The study of characteristics and dynamics of avalanche accidents and their evolution in the last decades allows experts to get important information for the sake of prevention and safety.

In the last 10 years, an increase in the number of accidents has been observed in early winter and mainly at the altitude range between 2,400 and 2,700 m asl,

especially in eastern Alps. The presence of hidden surface hoar layers often triggers avalanches both in northward and eastern and south-eastern slopes. As for south-eastern facing slopes, where a fairly high number of accidents are observed, the depth of avalanches triggered is lower than that of avalanches occurring on the other slopes.

Last but not least, as far as survival of buried people is concerned, the average time for recovering people alive by fellow hikers amounts to around 10 minutes, while average times for organized rescue teams to intervene amount to 62 minutes. In general, looking at the figures referring to the 2005- 2011 period, it is possible to see that survival times of buried people were better in Italian Alps compared with Switzerland and Canada.

### **Climate variability and avalanche risk in the Ossola Valley**

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The aim of this work was to analyze the main climate elements - temperature, liquid and solid precipitation - recorded by three weather stations of the Ossola valley (Alpe Cavalli, Alpe Devero and Formazza Vannino), in order to study their climate variability and verify the presence of variations of related indexes with time, through the detection of significant trends.

Climate figures are taken from paper annuals, drawn up for the former Servizio Idrografico e Mareografico Italiano (SIMI) (Italian hydrographic and marigraphic service) and stored at the Arpa Lombardia archives in Milan. The series of data were retrieved and digitalised in electronic sheet and daily temperature and precipitation figures then underwent quality control by using software RClimDex (Zhang e Yang, 2004). Once having found all dishomogeneities, temperature figures were homogenized using the SPLIDHOM method (Mestre et al., 2009). Then figures were aggregated on a monthly, seasonal and annual basis. Mean values were calculated for both the whole observation period and the last 30-year period (1971-2000) as defined by WMO (2007), and the main parameters and climate values were calculated also making use of software AnClim (Stepanek, 2005). The non-

parametric Mann-Kendall test (Sneyers 1990; 1992) was used to verify the statistical significance of trends. The study of trends confirms what had already emerged from other works that underline how climate changes have led to a significant temperature rise in the last thirty years (IPCC 2001; 2007). The lack of significant trends for precipitation data is in line with the results attained in other studies on the Alpine range (Beniston, 2000; 2005; Ronchi et al., 2008). Snowcover depth shows a significant decrease, obviously correlated with temperature rises.

The study then focused on the avalanche events taking place in 1985/86 and 2008/09 winter seasons, the two seasons with the heaviest snowfalls of the last 30 years. In the light of this analysis, experts drew up the Map of Probable Avalanche Paths (CLPV) of upper Antrona valley (Antrona Schieranco).

### **Assessment of future snow precipitation trends in the Italian Alps using general circulation models**

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General Circulation Models GCMs are widely adopted tools to achieve future climate projections. However, one needs

to assess their accuracy, which is only possible by comparison of GCMs' control runs against past observed data. Here, we investigated the accuracy of two GCMs models delivering snowfall that are included within the IPCC panel's inventory (*HadCM3*, *CCSM3*), by comparison against a comprehensive ground data base (some 400 daily snow gauging stations) located in the Italian Alps, during 1990-2009. GCMs simulations are objectively compared to snowfall volume by means of regionally evaluated statistical indicators. The *CCSM3* model provides slightly better results than the *HadCM3*, possibly in view of its finer computational grid. However, the performance of both models seems rather poor. We evaluated the *Bias*, or systemic error, between models and observations, that can be used as a bulk correction for the GCMs' snowfall simulations, and also for the purpose of future snowfall projection. We then carried out a stationarity analysis via linear regression and Mann Kendall tests upon the observed and simulated snowfall volumes for the control run period. We then used the properly Bias adjusted GCMs output for future snowfall projections from the IPCC-A2 *storyline*. Even when bias adjusted, the two analyzed models pro-

vide contrasting results about projected snowfall during the 21<sup>st</sup> century (until 2099). Our approach provides a first order assessment of the accuracy of GCM models in depicting past and possibly future snowfalls upon the (Italian) Alps, as well as a simple method to correct models' outputs for large scale studies focusing upon future snow conditions.

### **SNOW- PILLOW A small pillow for the measurement of snow density**

*P. Valgoi*

Throughout summer 2008, in the frame of several technical-scientific studies about the amount and spatial distribution of precipitation, A2A finished installation works of some innovative automatic weather stations at its dam sites in Valtellina, and specifically in Eita, Malghera, Val Cancano. The aim of these installations is to gather some additional information about snowcover density and temperature distribution inside it, in addition to the traditional temperature, rain and snow depth measures.

This paper wants to specifically illustrate the characteristics and operation of the pillow for snow density measurement (SNOW PILLOW).

