MOUNTAINEER-ORIENTED LOCAL AVALANCHE FORECASTING SYSTEM IN A GRAPHICAL FORMAT IN THE ARAN VALLEY (EASTERN PYRENEES)

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ABSTRACT: This paper presents a new avalanche danger information system. Internet based and with a graphical format, its display breaks down the information both by scale (entire valley, avalanche prone area, avalanche path) and by user level (from beginner to expert). It has been noticed that mountaineers have trouble when it comes to planning an activity to meet safety standards, due to the lack or scatter of information about the terrain and to the difficulties understanding and retaining the information contained in the avalanche advisories. In our valley, there is the additional problem of language, since we are located at the crossroads of four different linguistic areas. Thanks to a very dense observer network and to the forecasters' vast knowledge of the area, we have been able to develop an avalanche forecasting system for a series of mountain itineraries, which consists on a description of the itinerary -including the dangerous spots which might affect the safest trace- and a weekly update of the avalanche advisory. This last includes text, graphics, icons and interactive maps where the information is displayed in the form of traffic lights.

KEYWORDS: local avalanche forecast, graphic representation, Pyrenees, traffic lights

1. INTRODUCTION

How to present the information on the avalanche advisories so that it is easily understood has been a subject of debate in the past few years (e.g. EAWS, 2007). Avalanche advisories are meant to be understood by many different users, and not all of them have the same level of training to be able to understand and retain the information they receive. In regions where more than only language is used, as is the case in Europe, language also becomes an issue.

In the Aran Valley, the great amount of available data, the forecasters' good knowledge of the terrain and the new methods for evaluating snow stability have made it possible to provide more extended information in the advisories. A local avalanche forecasting method oriented to mountaineers has been developed. Internet based and with a graphical format, its display breaks down the information both by scale (entire valley, avalanche prone area, avalanche path) and by user level (from beginner to expert). The information is presented by means of maps, diagrams and icons. In the main screen, danger is represented by avalanche traffic lights, a format that is easily understood and remembered by users regardless of their language.

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1.1 The Aran Valley

The Aran Valley is a 600 km^2 territory presently under the administration of Catalonia (Spain). Located at the central part of the Pyrenean range, it stands halfway between the Spanish and the French states (Figure 1).

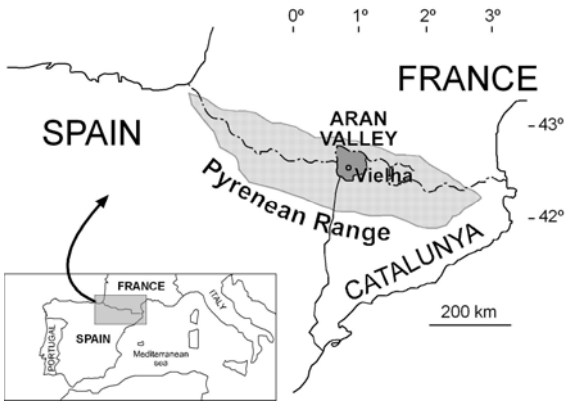

Figure 1: Study area.

The study area presents an oceanic climate, receiving a strong influence of the wet fluxes coming from the Atlantic Ocean. Precipitations are abundant, over 1000 mm per year, even reaching 1500 mm to 2000 mm. The total amount of fresh snow at 2200 m asl is about 500-600 cm per year and the distribution of precipitation is quite homogeneous throughout the year (Oller et al. 2006).

2. BACKGROUND

The widespread of avalanche danger information through the internet has made it possible to make considerable improvements in the way data is presented. In the past few years, some of the forecasting centers of the Alps have been showing part of their forecasts using a graphical format, and works are being conducted in order to create and apply an international standard (EAWS 2007). However, it is North America that leads the way in this subject, graphical display being the axis around which information is presented in some important forecasting centers (Tremper & Conway, 2006).

Avalanche study in Catalonia began in the late 1980's, when mapping and forecasting started to be carried out (Oller et al 2006). In the 2005-2006 winter season, a local forecasting for mountain itineraries was set up in the Aran Valley, providing specific (local) information on avalanche danger for the most visited areas (Gavaldà and Moner, 2006, 2008). Information was presented in classical text format, and it referred to a few itineraries.

3. LOCAL FORECASTING FOR MOUNTAINEERS

In the 2007-2008 winter season, thanks to experience and feedback, important improvements were made to our services. The forecasting system is now mainly graphical and available at http://www.lauegi.conselharan.org/. It is made up by two components: a permanent part –the itineraries fact sheet- where several ascents and tours are described, including the dangerous spots or areas which might affect the safest track or its surroundings; and a weekly update of the avalanche danger providing information on overall and specific avalanche danger.

3.1 Itineraries fact sheets

The 17 chosen itineraries register a big part of the mountaineering activity of the valley. They include the access routes to guarded refuges, the routes that link them, and the most typical and emblematic ascents. Each trace is chosen on the basis of the forecasters' knowledge of the area and the IGC's 1:25000 Avalanche Paths Maps. The description of each itinerary focuses on the avalanches that might affect it. The text goes together with plenty of graphical material, maps and photos where the safest trace and the dangerous areas and spots are represented (Figure 2).

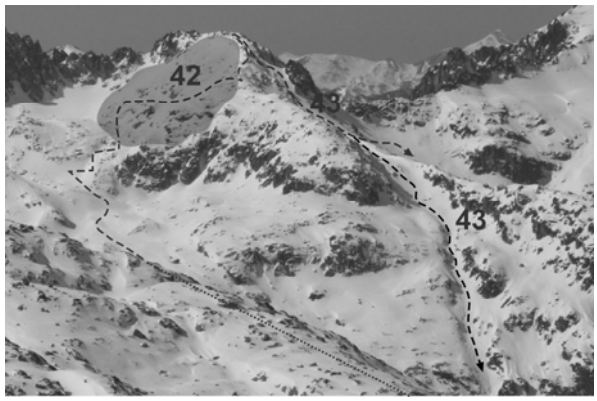

Figure 2: Example of photos indicating the safest trace and the dangerous spots.

On the set itineraries, we have identified several spots where the safest trace might be affected by avalanches. These spots have been described, mapped and classified according to their main characteristics (type of avalanche, aspect, height, wind loading, slope, terrain traps), grouping them into different categories so that the observations made at certain spots might be compared or applied to other similar ones.

3.2 Avalanche danger update

In order to prepare our forecast, we use the network of snow and weather observations shown in Figure 3. These data are complemented by the forecasters' field observations, conducted with the aid of Rangers from the Environment Department and with the contribution of guides, refuge guards and local skiers and snowboarders.

The evolution of the snowpack is followed-up on a daily basis. The day before updating the forecast, we go out to the field in order to visit the areas for which we have less information. In this way, direct information of approximately 25% of the dangerous spots is obtained.

With the gathered data, we evaluate the stability of the selected spots and the spatial variability of avalanche danger. Variability is estimated by comparing the stability of several dangerous spots belonging to the same category. When danger distribution is homogeneous, the stability of the spots we have not seen directly can be deduced from the nearby spots belonging to the same category for which stability has been checked. When distribution is heterogeneous, no information is provided for spots which have not been checked in the field.

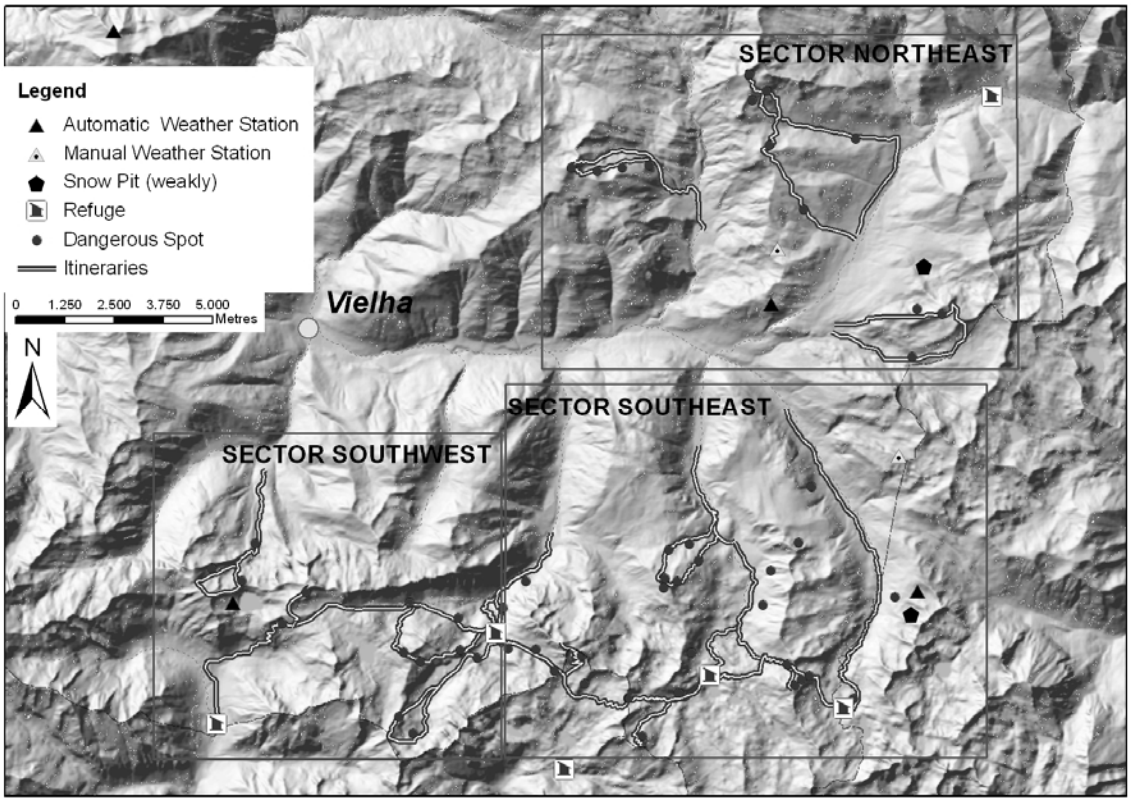

Figure 3: Forecast sectors, with set itineraries, identified dangerous spots and available snow and weather data. The three sectors cover a total area of approximately 250 km^2 and the heads of the basins, where danger is higher, are approximately a third part of this area.

For each dangerous spot, the probability of an avalanche release (that might affect the trace) is established, as well as the size –in proportion to the avalanche path size- that the forecasted avalanche could reach. The color of the traffic light is decided on the basis of these two parameters and of the specific characteristics of each spot (such as the presence of terrain traps).

4. GRAPHICAL REPRESENTATION OF AVALANCHE DANGER

In the final display, data are presented in an escalated manner. According to geographical scale, information is divided into regional and local. Regional information provides overall facts, whereas local information describes the specific state of each dangerous spot. Information is also sorted out according to user level, with sections for beginners, intermediate and expert users (Figure 4).

4.1 Regional information

Under the name of Overview, this section presents a typical, text format, avalanche advisory and a graphical heading representing the information on snowpack distribution and avalanche danger with aspect/height diagrams.

4.2 Panoramic local information (traffic lights)

The information contained in this section refers to the dangerous spots established in the itineraries fact sheets. For each spot, a traffic light indicating the degree of avalanche danger is shown on an interactive map (Figure 5).

A red light indicates not to pass, a yellow one, to take special precautions and re-evaluate danger continually, and a green one, no Danger is observed but safe travel techniques are applicable. Also, a white traffic light appears when there is no snow in the sector, and an inactive one (grey) when danger is unknown.

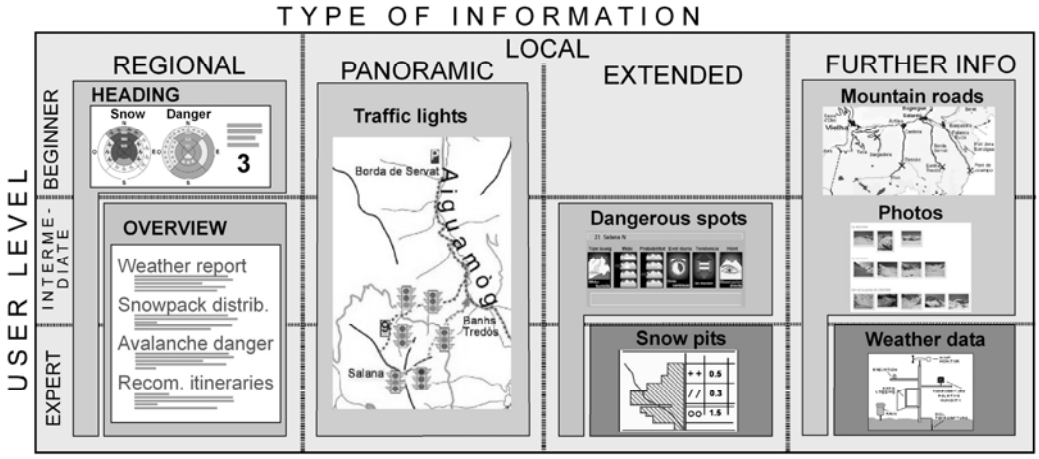

Figure 4: Scheme of the components of the graphical avalanche danger information system.

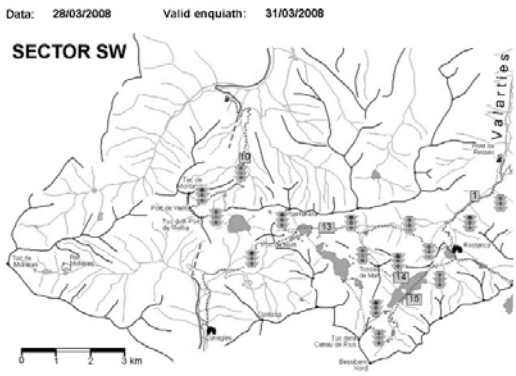

Figure 5: Example of interactive map showing different degrees of avalanche danger by means of traffic lights icons. Dotted lines represent the itineraries covered.

By clicking on each traffic light, a window with additional information is activated.

4.3 Extended local information

This section is addressed to intermediate or expert users and it provides extended information for each dangerous spot.

- Dangerous spots. For each dangerous spot, the following parameters are described: avalanche type (new snow, slab or wet snow), avalanche size (slush to big), probability of release (very low to very high), variation (if danger changes throughout the day), trend (for the following 48 hours) and source (direct observation or inferred information) (Figure 6).

Figure 6: Example of the description of a dangerous spot

- Snow pits. Hand snow profiles and stability tests, together with close-ups, panoramic photos and a comment on the most relevant characteristics.

4.4 Further information: mountain roads, photos and weather data

Information is completed with photos of the past week's avalanche activity and of the snow cover. A map showing the condition of forestry tracks and high mountain roads is also provided, indicating how far you can go by car or by 4x4. Finally, the data provided by several automatic weather stations are offered in real time.

5. CONCLUSIONS

The development of a mountaineer-oriented local avalanche forecasting system has made it possible to provide users with extended information on itineraries and specific dangerous spots. The graphical format in which information is shown makes it easily understandable and adjustable to user level and to different geographical scales.

Experience, feedback, improvements on the web site and on graphical applications, and the installation of internet access in mountain refuges – enhancing communications-, will all contribute to the further improvement of our forecasting system in future seasons.

6. ACKNOWLEDGEMENTS

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