# ALLAUS.AD: A NEW WEB-BASED PLATFORM FOR AVALANCHE INFORMATION AND DISSEMINATION IN ANDORRA

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ABSTRACT: The ALLAUS.AD web-based platform is created to centralize and homogenize all data related to avalanches, giving information that helps to improve the products already available, provide quick access and visualization. This platform will be composed of 3 main sections: 1) Information (conditions and advisory, terrain and group), 2) Dissemination (news, training courses, social networks) and 3) Visualizer and database (accidents, avalanche cartography, evolution of snow cover). The web-platform is currently being developed but certain content is already public, such as the Avalanche Terrain Exposure Scale developed in the country, the access to avalanche advisory and link to the meteorological and the avalanche bulletin.

KEYWORDS: Avalanche risk, education, forecasting, web-based platform, prevention.

## 1. INTRODUCTION

Snow avalanches cause annually damage of billions of euros in settlements and economic activities, and hundreds of deaths around the world. The most advanced regions have developed more or less effective defense measures and Andorra is not an exception, but in recent years dozens of accidents continue to occur, generating economic and human losses in a vulnerable territory, where exposure to occurrence of this phenomenon has increased.

Andorra is a small country (470 km$^2$) located in the central Pyrenees, between France and Spain. The average altitude is 1.893 m, with altitudes ranging between 830 m and 2.942 m, and with 65 summits of more than 2.500 m high. The country is furrowed by two main rivers and its corresponding valleys: Valira del Nord in the west and Valira d'Orient in the east. These two rivers converge in Andorra la Vella to create the Valira river (Fig. 1). Because of the altitude, much of the territory frequently snow-covered during winter months, and the highest parts potentially remain under the snow during 5 months approximately (Batalla et al., 2016). Another factor to take into account is the great amount of buildings and infrastructures exposed to avalanches due to the high population density of the country, around 170 inhabitants/km$^2$ in 2017 (http://www.estadistica.ad).

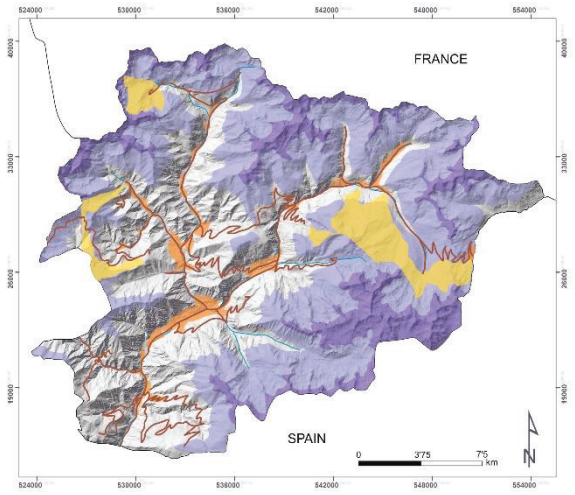


Figure 1: Map of Andorra. Light purple: area above 2.000 m high; dark purple: area above 2.500 m high; orange: main inhabited zones; yellow: ski resort zones; brown lines: main roads; blue lines: main rivers.

Since 1971 we have reported 18 people dead in Andorra caused by avalanche accidents (Gallego et al., 2011; Apodaka, pers. comm.), and many affectations to infrastructures (e.g. Arinsal avalanche in 1996, which destroyed entire inhabited buildings).

## 2. AVAILABLE DATA

In Andorra, there is a large amount of data available related to avalanches. The Andorran Meteorological Service updates every morning at 8:30 am an avalanche bulletin based on data from the ski resorts, the rangers and the automatic weather stations. This information, valid for the present day, takes into account the snow cover from the previous day, its nocturnal evolution and

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the daily forecast. It also shows the avalanche danger in three different areas (North, Centre and South), and specifies the altitude and the aspect of the mountain that could be mostly affected by the avalanche. In addition to this, Météo France provides every afternoon at 4:00 pm, another avalanche bulletin generalized for the whole country, complementary to the former one and only valid until the next morning, that includes the data compiled by the meteorological service during the day, plus, the prediction of the coming night. Civil Protection send out their warnings when necessary, and the Fire-Fighters' Rescue Team share safety and prevention advices regularly in social media. It exists also some information about artificial avalanche triggering operations by the ski resorts and the road service, only available for professionals on request. Finally, data from research and education is managed by the Snow and Mountain Research Center of Andorra (CENMA-IEA). Amongst others, we have developed the Avalanche Terrain Exposure Scale (ATES) in Andorra, a risk management tool for practitioners and professionals (Statham et al., 2006; Campbell and Gould, 2013).

## 3. ALLAUS.AD PLATFORM

The ALLAUS.AD web-based platform is created to centralize and homogenize all data related to avalanches in Andorra, giving information that can help to improve the products already available and provide quick access and visualization of the available data. The website will also be adapted to be compatible with any mobile phones device and tablets. This platform is currently being developed, and it will be composed of 3 main sections: information, dissemination and visualizer and database.

### 3.1 *Information*

In this section, which is already public, there is iconic information about the weather and avalanche risk, as well as a link to the weather and avalanche forecast. The main screen of the viewer is focused on the ATES, which is represented in a shaded DTM for each valley (Fig. 2). Suggested routes are drawn on ATES maps, and an itinerary info sheet for each route is available online and for downloading in pdf format (Fig, 3). Information about decision and alert points is given for each route. In addition, Avaluator™ trip planner (Haegeli et al., 2006) is relating the type of terrain with the avalanche danger scale, highlighting the avalanche danger of the given day. The section also includes a wide explanation about what is ATES and how to use it, a terrain catalog including pictures illustrating the different types of terrain together with examples of terrain traps, and some advices for low risk winter circulation in avalanche terrain. It will also include a section with photos depicting some situations which are typical in avalanche advisory.

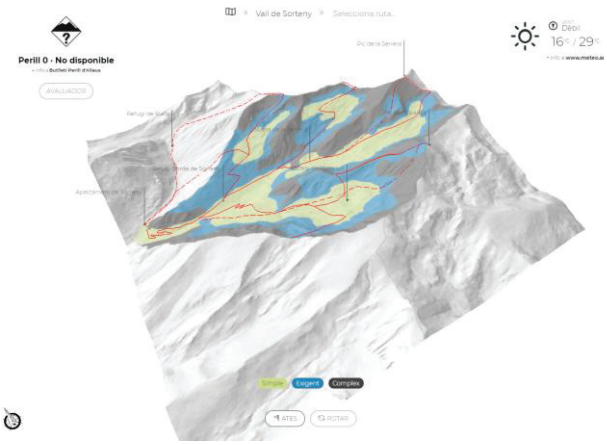


Figure 2: Caption of the current allaus.ad web page. The central part is devoted to ATES, while on top left and top right we can find iconic information about the avalanche danger level and the weather forecast, and their respective links.

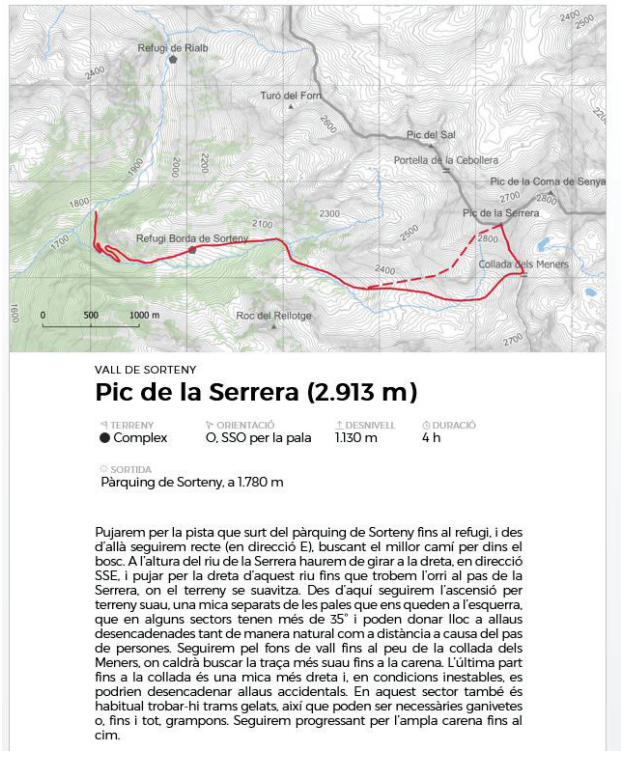


Figure 3: Example of an itinerary info sheet.

### 3.2 *Dissemination*

This section is currently existing in another platform (http://www.iea.ad/edna) and is devoted to give basic concepts of weather, snow, avalanches, terrain and rescue. It also includes information about training courses held in Andorra.

### 3.3 *Viewer and database*

The newest section of this platform is still being developed. In order to centralize and homogenize data existing, we are creating several databases related to avalanches, including: accidents occurred during the last 45 years and affecting people and/or infrastructures, results of the artificial avalanche triggering operations in ski resorts and in roads, probable avalanche paths (Cadastre d'allaus d'Andorra, http://www.cadastreallaus.ad/), or evolution of snow cover through snow pits, stability tests and other observations. These databases will be represented in a GIS environment in order to facilitate quick access and visualization and, on a first stage, is expected in a future to be constantly fed by all organizations implied (ski patrollers, avalanche forecasters, rangers, rescue teams, civil protection, researchers). On a second stage, we are assessing the possibility to make this platform open public to visualize and check snow and avalanche information and provide crow-sourced information.

## 4. CONCLUSIONS

Avalanches caused in the last years important economic and human losses in Andorra. The exchange of immediate information within all organizations implied in the safety operations around the country is a basic task in order to facilitate and optimize these safety operations (e.g. artificial triggering, avalanche forecast or evacuation, amongst others). Moreover, there are more and more practitioners of winter sports who get exposed to avalanche terrain.

We propose a web-based platform supplying all information available about avalanche: in one hand, public tools and information such as the links to the avalanche bulletin and meteorological forecast, ATES cartography or training courses; and on the other hand, an operative database and GIS environment created to share information about observations in order to support technical teams on decision-making.

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