

## LOCAL AVALANCHE DANGER ASSESMENT IN REDUCED MEANS CONTEXT: AN EXEMPLE IN TETNULDI SKI AREA (GEORGIA – CAUCASUS)

ESCANDE Sébastien<sup>1\*</sup>, LAPALUS Jean Christophe<sup>2</sup>, MARION Frédéric<sup>3</sup>

<sup>1</sup> French National Association for Snow and Avalanche Study (ANENA), 15 Rue Ernest Calvat, 38000 Grenoble - FRANCE.

<sup>2</sup> Compagnie des Alpes Management CDAM Deux-Alpes Loisir, 38860 Les Deux-Alpes, FRANCE

<sup>3</sup> Compagnie des Alpes Management (CDAM) International, 50-52 bd Haussmann 75009 Paris - FRANCE

**ABSTRACT:** The development of Georgians ski resort involves several skills, including local avalanche danger assessment. Human organization and financial context limit possibilities of the Georgian ski resort to simple but efficient solutions. A technical cooperation between Anena and CDAM (Compagnie des Alpes Management) lead to this goal through a training program during winter 2017-2018 in Tetnuldi (Georgia - Svanetia).

We have developed a method suitable for Georgian ski patrollers team to assess an avalanche risk level and communicate it to their guest.

The logic adopted is to rely for the different stages of the process on existing international tools: from Switzerland (*Avalanche Problems Analyzer*) and Canada (*ATES classification of the terrain : simple, challenging, complex*). A specific synthesis grid « local Avalanche Danger Assessment » have been built on three criteria: what avalanche Problem? (for everyone, a ranking from *favorable* to *unfavorable* - green: risky 1 to red: risky 4), where are the problems located (for each situation: aspect, elevation, particular configuration), observable (local observations: avalanche activity, accumulations).

**KEYWORDS:** Avalanche Danger Assessment tools, risk management Education, avalanche terrain classification

### 1. INTRODUCTION

Georgia, set in the heart of the Greater Caucasus, contains the highest mountains in Europe and a rich cultural heritage. The Georgians ski resort development is managed by a public structure Mountain Resort Georgia (MRG) from two years now.

The development of the ski resorts involves several skills, including local avalanche danger assessment. For these topics, the technical cooperation between Anena and CDA (Compagnie des Alpes) lead to this goal through:

- providing a basic working framework for MRG teams,
- training program during winter 2017-2018 in a pilot site : Tetnuldi ski area (Svanetia).

### 2. PRESENTATION OF THE COOPERATION PROGRAM

During the 2017 winter, an CDAM team visit different Georgian ski resort. They discover variety problematics in each resort, depending on the profile of the station (character of the land, clientele encountered, ...). On two of them, Tetnuldi and Gudauri, set in the great caucasus range, specifics difficulties appears on off-piste and local avalanche danger assessment.

The year after, for the 2017-2018 season, cooperation MRG/CDAM is enlarged with Anena's specialist for different session :

1/ one early session (November) oriented towards winter season's preparation and review of the suggested previous improvement for ski run slopes and grooming. One specific focus was paid to off-piste topic with equipment review , avalanche risk management and zoning.

2/ winter session in successive period from January to April. Purpose consists in supporting management and training teams regarding avalanche risks estimation, off-piste rescue, risk management, guest information.

The pilot site for the methodologic development and the training session for Georgian ski-patrollers team is chose in Tetnuldi ski-area, in the wild Svaneti district, close to its capital town, Mestia.

During this cooperation program, we must be able to find the best working methods, according to local human organization and financial context. The possibilities of the Georgians ski resort lead to simple and suitable solution to assess an avalanche risk level and communicate it to their guest.

---

\* Corresponding author address:

Escande S., French National Association for Snow and Avalanche Study (ANENA), 15 Rue Ernest Calvat, 38000 Grenoble - FRANCE,  
tel: +3 3476-51-39-39; cell: +3 3687-452-487  
email: sebastien.escande@anena.org



Figure 1: The location of Svaneti , 300 km North-East of Georgia's capital Tbilisi,

### 3. DEVELOPMENT

According to the Georgian reduced means context, we have developed a method suitable for Georgian ski patrollers team to assess easily an avalanche risk level and communicate it to their guest. Our goal was to provided technical support by using and adapted International systems (from France, Canada and Switzerland). We remain on the evaluation of a risk at the scale of one resort and not of a complete massif. The logic adopted is to rely for the different stages of the process on **existing international tools**:

- in **France** (*local Avalanche Danger Assessment*) and **Switzerland**(*Avalanche Problems Analyzer*) for step 1
- in **Canada** (*ATES classification*) in Step 2
- in **Canada** (*Avaluator*) for daily public display and customer info in the field in step 3

#### 3.1 First step: local avalanche danger assessment

We Develop a method and documents to assess an avalanche risk level over the ski area with our reduced means context. The **first step** is to carry out an **avalanche risk forecast** (for the perimeter of the resort) through day-to-day reconnaissance of various typical avalanche situations (link between weather and snowpack) and to qualify them (from *favorable* to *unfavorable*.)

Three criteria must be determined each day (or with each significant change at least):

#### 1 / What avalanche Problem?

We have used the typical avalanche problems and their symbolic as defined by the European Avalanche Warning Services EAWS (2017). Our form tool described 4 (of the 5) typical problems. For every problem, a ranking from *favorable* to *unfavorable* (green: risky to red: risky) by using very few but pertinent criteria :

- new snow: amount (10 to 40 cm), wind and warmer,
- slab (or snow-drifted snow): local to general ,
- persistent weak layers : far inside snowpack or obvious,
- wet snow: melting to strong rain

#### 2 / Where?

Where are the problems located for each situation: aspect, elevation (by using classic avalanche bulletin symbolic), particular configuration

#### 3/ Observable?

Evoke some local observations :

- 1/ Alarms signs and main clues,
- 2/ avalanche activity, their size, aspect, elevation and specific location. To qualify the size of the observed avalanches, we have proposed values adapted from Canadian destructive Avalanche Size Scale, adapting it: Medium is between path length 100 m and 500 m, etc...
- 3/ snowpit and weather observation in middle (2000 m) and upper level (3000 m) of the ski-area

The following form "*Local Avalanche Danger Assessment*" (see figure 2) is proposed as an overall summary document

| LOCAL AVALANCHE DANGER ASSESSMENT                                                                                                   |                                                  |                                                                                    |                                                                        |            |         |              |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------|---------|--------------|
| What AVALANCHE PROBLEMS ?                                                                                                           |                                                  |                                                                                    |                                                                        |            |         |              |
| <div style="display: flex; justify-content: space-around;"> <div>1 </div> <div>2 </div> <div>3 </div> <div>4 </div> </div>          |                                                  |                                                                                    |                                                                        |            |         |              |
| <table border="1" style="width: 100%;"> <tr> <td>Accidental</td> <td>Natural</td> <td>Main Danger:</td> </tr> </table>              |                                                  |                                                                                    |                                                                        | Accidental | Natural | Main Danger: |
| Accidental                                                                                                                          | Natural                                          | Main Danger:                                                                       |                                                                        |            |         |              |
| <b>Fresh Snow</b><br><br>1 2 3 4<br>10 cm 40 cm Wind/warmer                                                                         | <b>Wind Slab</b><br><br>1 2 3 4<br>Local General | <b>Persistent weak layers</b><br><br>1 2 3 4<br>Far inside snowpack Obvious (test) | <b>Wet snow</b><br><br>1 2 3 4<br>melting Strong rain                  |            |         |              |
| Where ?                                                                                                                             |                                                  |                                                                                    |                                                                        |            |         |              |
| <br>Near ridges / pass<br>« cold » slopes                                                                                           | <br>Specialty in altitude<br>« cold » slopes     | <br>Even far from ridges/pass<br>Leewards slopes                                   | <br>« Cold » slopes (shadow)<br>Even in distance of large/steep slopes |            |         |              |
| Other : .....                                                                                                                       |                                                  |                                                                                    |                                                                        |            |         |              |
| Observable ?                                                                                                                        |                                                  |                                                                                    |                                                                        |            |         |              |
| <b>Alarm signs:</b><br><br>none few frequent several                                                                                |                                                  | <b>Description of the main clues :</b>                                             |                                                                        |            |         |              |
| <b>Avalanche activity /Size (path length) :</b><br><br>Very small Small Medium Large<br>< 100 m 100 to 500 m 500 to 1000 m > 1000 m |                                                  | <b>Where :</b><br><b>Specific location :</b>                                       |                                                                        |            |         |              |
| <b>Snowpit</b><br>Elevation ~ 2000 m                                                                                                |                                                  | Elevation ~ 3000 m                                                                 |                                                                        |            |         |              |
| <b>Weather</b>                                                                                                                      |                                                  |                                                                                    |                                                                        |            |         |              |
| Observer/Patrolor's name                                                                                                            |                                                  | Date                                                                               |                                                                        |            |         |              |

Figure 2: Local Avalanche Danger Assessment form (ANENA-2018)

To fine-tune the analysis of each avalanche problem, we have use during the winter training session a more complete Swiss tool : the *Avalanche Problems Analyzer*, English translate from German of the Muster Analyzer, Harvey (2015)

### 3.2 Second step: map the difficulties of the field

The second step was to map the difficulty of a field, for that we have purposed to use the *Avalanche Terrain Exposure Scale (ATES)* , Stat-ham & al. (2006). We have use the technical model to classify the different area.

We propose the classification on **3 levels** (Simple, challenging, Complex) for the Telnuldi ski-area on different pictures in order to simplify their use by ski-patrollers (see Figures 3)

#### Telnuldi : main Off-piste areas (2018)

**Avalanche terrain classification (ATES method) :**

- 1 **Simple** (less than 30°, no directly dominated)
- 2 **Challenging** (30° slopes, some terrain trap)
- 3 **Complex** (long 30° slopes, gullies, upper part of a face...)

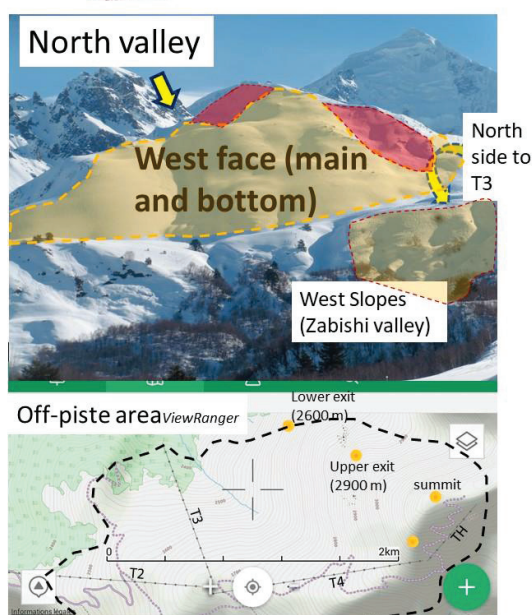


Figure 3: Representation of the ATES classification in Telnuldi ski-area

### 3.3 Third step: associate the ranking of terrain difficulties with the forecast

The **third step** consists in associating the ranking of difficulty of a terrain with the forecast of the risk of avalanche with finally the display to the customers.

According to the international scale, the different levels will be used for customer information, especially for off-piste practices (see Figure 4).

- 1  **Danger Rating 1 (Low)** : good security level on all terrains *simple* to *complex*
- 2  **Danger rating 2 (moderate)** : good security level on *simple* terrains or *challenging*, excepted for orientations/configurations specified as risky. *Complex* terrains to deal with specific strategies. Typically, in Telnuldi, the north face beside TH
- 3  **Danger rating 3 (considerable)**: *challenging* terrains have to be crossed only with specific strategies. Progressing in *complex* terrains is very tricky (only with professional guiding). In Telnuldi, the opening of T3 and T4 is conditioned by the advice and survey given to the skiers. TH (the upper one) could be sometimes be closed.
- 4  **Danger rating 4 (High)** : only visit *simple* terrains, *challenging* ones are really tricky and *complex* highly risky. In Telnuldi we recommend to close T3+T4+TH, opening the T1 and T2 until 2695 m and the T9
- 5  **Danger rating 5 (Very high)** : In Telnuldi, all the ski-resort will be closed (access problem up and down along the road), skiers staying in Hatsvali ski resort

Figure 4: Avalanche danger customers information in Telnuldi area according to international avalanche risk symbolic

For helping the avalanche risk information to the guest, A graphical representation is possible on a Canadian tool: the *Avaluator-trip planner*, Canadian Avalanche Center (2007). It could be a good opportunity for the future, after one or two first winter season.

## 4. TRAINING ON TECHNICAL TOOLS

The technical tools and methodology proposed have been deployed on Telnuldi this winter with two main goals :

- Train on nivology, structured risk analysis a part of the ski-patrollers team who will be responsible for assessing the avalanche risk on site
  - train the whole team to the off-piste, safety rules, knowledge of the safety equipment (DVA, shovel, probe, ABS) and its use.
- This paper focus on the first point

The main methodologic sheet (Local Avalanche Danger Assessment form- see figure 2) have been translate in Georgian.

We have completed it every day during the second part of the winter season (from march to April). During march, avalanche danger was often 3 (or more) up to 2600 m (summit ski lift T2) with all typical avalanche problems present.

We have discovered that the Gliding snow avalanche problem have been problematic



after mid-march. The avalanche danger assessment form will be complete with this situation

We attempt to give to a team of 6 Georgian ski-patrollers a complete training with the IFMGA/Anena Avalanche Education contents:

- typical avalanche problems and focus on avalanche slab mechanism. We have done different snowpit,
- Equipment knowledge and use : transceiver group check, specific simple rope technics (handrail) for secure easily someone (specialy useful in the north face entrance close to cornices), perform a rescue with 2 or more victims ...
- being comfortable with a structured analysis: 3x3 approach, the vigilance mode tool (Data-Avalanche, 2017) and the "MusterAnalyser" tool
- Trip planning introduction and risk management. For that, we show them a free numerical map tool: the viewrangerApp which give the opportunity to identify strategic waypoint for the security and share located observation within the ski-patroller team (see Figure 5).

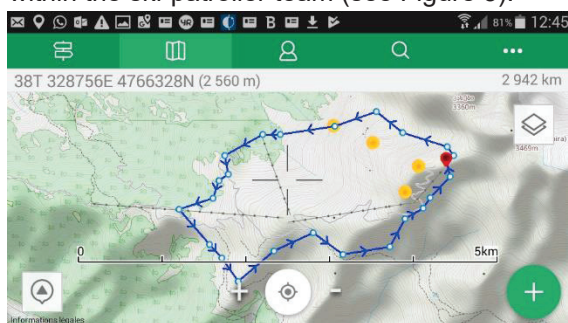


Figure 5: ViewRanger App extract : record of the limit of off-piste area (blue). In yellow, some particular point : summit...)

Another technical point have been done several time : the slope angle evaluation, especially with ski poles (see Figure 6), a pedagogical video have also been done. This point is really strategic for helping them to identify precisely terrain complexity (according to the ATES classification) and avalanche risk in their different off-piste area.

It could be useful for their own security during the morning tour before opening to the customer or give advice to their guest in the field.



Figure 6: Georgian ski patrollers are doing a slop angle evaluation after triggering a slab

- Of course, all the classic behavior rules in the field have been considered : one by one, safety point, importance of the communication among ski-patrollers (briefing, instructions : visual and verbal)

## 5. RESULT OF THE MONITORING

Different session have led to give first organization frame-work and recommended first procedures. Off-piste security issue is critical in Tetnuldi and also part of the destination's attractiveness, growing from year to year. The core idea of the different winter 2017-2018 mission consists in supporting MRG for implementing quickly first step of avalanche risk estimation and zoning system as presented on point 3 and 4.

The information system to clients and stakeholders for preventing risky situation have just begin in the second part of the season, after mid-march, when all the training session were done and the different tools understood.

We have seen MRG ski-patrollers teams with professional skills, close to European standard, even with reduced means (few local observations, quite new knowledge or training on the different topics).

Furthermore, from 10 of march to mid April (close of the ski-area), ski-patrollers have been, able, by using these basic frame-work, to improve dramatically security level through proper use of safety equipment, avalanche risk information (see Figure 7 and 8) and operational measures for preventing access in case of unfavorable situation in comparison with current context.



Figure 7: Georgian ski patroller give information to guest by using an information panel (in the back) and the "Local Avalanche Danger Assessment" form (on his hand)



Figure 8: Risk information panel (existing in two places in the ski-area) using international Avalanche Danger Symbolic; details are given by drawing on the bottom part : description of main avalanche problems, localization and specific observation of the day.

3 / Create a network between all the Georgian stations to exchange the daily observations (weather, nivology).

## ACKNOWLEDGEMENT

CDAM team and Anena has been supported during all the sessions and for logistics by Mountain Resort Georgia (MRG)Team, specially Mr. Vako Dundua and Mrs Miranda Agapishvili and a very motivated ski patrollers team in Telnuldi We thank them for their efficient help.

## REFERENCES

- General Assembly of EAWS, 2017: the typical avalanche problems
- S. Harvey, 2015\_MusterAnalyser\_2\_0\_EN
- G. Statham, B. MacMahon, I. Tomm, 2006: The Avalanche Terrain Exposure Scale. Proceedings of the International Snow Science Workshop, Telluride, CO, 491-497.
- Canadian Avalanche Center, 2007; Avaluator Trip planner
- Data-avalanche, 2017: vigilance mode tool\_EN

## PERSPECTIVES

The development of Georgians ski resort involves several skills, including local avalanche danger assessment.

A big path has to be done for integrating methods and educating as much as possible customers

We have to imagine in a few years Georgian experts in different fields such as snow, weather, mountain terrain, snowpack, snow barrier, rescue, avalanche search, track, signage, damage, evacuation lift, ..) and that these experts can go for training to all resorts and thus establish coherence.

On our topics, the concrete perspectives for the next seasons could be :

1 / Deploy the previous axes elsewhere (specially in Gudauri, the other main Georgian off-piste area, closer to Tbilissi.

2 / Set up a daily monitoring on the nivology and the weather with recording data in order to constitute a history on each site.