

A LOOK BACK ON THE AVALANCHE CYCLE IN QUEYRAS IN DECEMBER 2008. International Snow Science Workshop 2010

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ABSTRACT: Almost ten years after the catastrophic avalanche in Chamonix, which killed 39 people in February 1999, the French Alps has been the theatre of a new surprising avalanche crisis in the Queyras massif and the Tinée's valley, closed to the border with Italy. In the middle of December, about 3 meters of snow fell in 3 days in the village of Abriès at 1500-meter above sea level. In consequence, on the 16th of December 2008, many avalanches occurred in those two regions and some of them were unexpected. Classical big avalanches were observed and created big accumulation on roads and in wild valleys. Also, unpredicted avalanches occurred and created damages never seen before.

This avalanche cycle has been really surprising on different points. First, we have observed avalanches unknown in the human memory of a local mountain population. Moreover, a great number of avalanches in a short period have occurred. Several damages has been observed and we noticed that the biggest damages concerned sometimes relative small avalanches. We want to present and to analyse some events particularly surprising for the reasons cited higher.

We want to share in ISSW the results of this crisis and how French authorities took in charge the situation. We will describe the procedures used for the safety of population. We'll explain how those systems are linked and organised (communes, weather forecaster, decisions). We can notice that difficulties appeared in their application in time.

1. INTRODUCTION

The notion of "avalanche cycle" commonly names an abnormally high number of avalanches in time and in space. Such an event happened in December 2008 in the South-East of the French Alps. It generated a crisis situation and numerous disruptions. Villages from the bottom of the valley (like the comb of Queyras) were cut off from the rest of the world because roads were cut off themselves. It was the same for ski resorts (like Isola 2000). Several chalets were damaged, notably in Ristolas (05) and St Etienne de Tinée (06). Some ski installations were also damaged, as some forest plantings. Fortunately, there was no human victim, even if, during the crisis, several persons, including a child, were buried by an avalanche, for 50 minutes, in Ristolas, on December 16th. In this article, we will describe some particular cases of avalanche. We will propose some analyses and show how a crisis situation could be managed.

2. LARGE SCALE STATISTICAL STUDY OF THE CYCLE

The avalanche cycle has concerned the major part of the French Southern Alps. A very precise statistical analyses about this avalanche cycle has been realised by the Cemagref Institute and "Meteo France" (Eckert and Al, 2010). This study, based on data taken from the EPA net, gives much information about the spatio-temporal patterns encountered of the cycle: the spatial repartition of the events, their numbers, the return period of snowfalls, the return period of avalanche...

It is shown that 3 massifs of the French Alps have been concerned by a high number of avalanches on a short period in the middle of December (Figure 1). The Mercantour range has been the most concerned by the avalanche cycle with a number of 46 avalanche for a rate of 0,24 avalanche per path. In the Queyras' massif, the number is inferior, 42 avalanches for a rate of 0,21 avalanche per path. Nevertheless, the most interesting area to study in detail is the Queyras massif, for the reasons explained later in this article.

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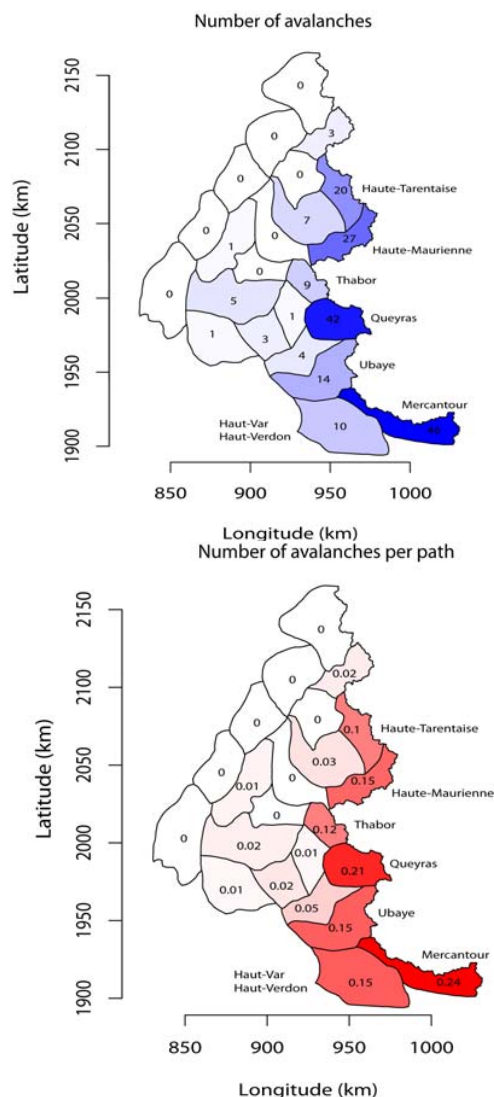


Figure 1: Numbers of avalanches per path (From Eckert and Al, 2010)

The major avalanches happened in this massif on the 16th and 17th of December while the snow and weather condition were unified for the realising of the avalanche. This is the reason why we will speak of an avalanches cycle.

In the rest of this article, we will describe and analyse some special events resulting of this exceptional amount of snow in Southern Alps, especially on the border massif.

3. SOME EXCEPTIONAL EVENTS

The avalanche cycle of December 2008 is striking for three reasons.

- The importance of the observed phenomenon/avalanches. Indeed, the importance of the cold and light snow pillow, from the bottom to the

top of the slopes, enabled many avalanches to cover long distances and favoured the development of sizeable powder clouds. The extreme sizes of the largest known avalanches (repertorised in the CLPA) were sometimes exceeded.

- The important number of phenomenon. During that month of December 2008, in seven towns of Queyras, 34 phenomenon were repertorised by the agents of the RTM-Hautes-Alpes, as new or creating a modifications of their schemes on the CLPA. These towns are: Aiguilles (2 avalanches), Abries (10 avalanches), Château Ville Vieille (2 avalanches), Ristolas (10 avalanches), Ceillac (3 avalanches), Arvieux (2 avalanches), St Véran (1 avalanche), and Moline en Queyras (4 avalanches). Moreover, in numerous sites, the avalanches reached their maximum-known size but didn't exceed it.
- The surprising nature of some avalanches and their diversity in size. Avalanches starting on not very sloping hillsides, in forest zones, or the differences of covered ramps caused damages on buildings in unexpected places, whereas other more usual phenomenon surprised people by exceeding their usual size. Avalanches never seen before took place on small slopes above the valley, regardless of the orientation.

This article proposes an analysis of noticeable avalanche cases during this crisis.

As an illustration, the following map shows the comparison between the historic events repertorised on the CLPA in 2001 and those that took place in December 2008 in the area of Abriès and Ristolas. Note that Queyras faced another avalanche succession in April 2009, this time in moist snow conditions. It was less important but however, exceeded the CLPA measures.

4. IMPORTANT SIZES:

Most of the avalanches that took place in the course of this crisis were already known phenomenon, either frequent or rare.

Though, some of them were very surprising, because they greatly exceeded the maximum sizes repertorised on the CLPA.

The avalanche of Costeroux, in "Molines en Queyras", started on slopes on South and East aspects, under the "Pic du Fond de Peynin", culminating at 2912m. A large failure spread between 2700 m and about 2840 m a.s.l. from the crests of Peyre Nière. The flow followed a trajectory jutting out from the ones repertorised in the CLPA,

and it was at least twice as large. The avalanche then crossed the projecting ledge of “Pra Soubeyran” and split into two strips on a hilltop. Both strips reached the road which was cut off on 400 metres between the cross and the oratory at the edge of the village of Fontgillarde.

The starting area squares with the measures written out on the CLPA in 2001, measures stemming from the account of very important events. Indeed, only four avalanches were known in this area, and had destroyed buildings in 1706, 1728, 1788. The most recent observation dated back from 1803.

The avalanche of “Costeroux” generated one of the numerous updating that must be made in the CLPA after the avalanche succession of December 2008.

In order to characterise the distinctive features of this avalanche succession, we must also take into consideration the sometimes very large avalanches which happened without exceeding or almost not, the measures of the CLPA. This is what happened with the Avalanche de la Fourche, at the edge of Abriès. This well-known path gave rise in December 2008 (Figure 4), to a phenomenon that cut off the road to Ristolas on 400m wide. According to the CLPA, the last important event dates back from 1946. Uphill from Ristolas, all the avalanches of the right side of the valley came down (from the Crest of “Peyre Plata” to the “Tête de Pelvas”) cutting off the RD947 on hundreds of metres on several spots.

Analysis: in these two cases, the main difficulty was drawing a map of the phenomenon as a whole, a difficult task because of the important difference in ramps and shifting problems after the crisis. In this case, photographs taken right after the crisis from a helicopter put forward many elements to analyse. However, in cold snow, the limits of significant measures of the avalanches are not distinct; especially if there has been new precipitations or wind. A tour made late in the season (after the melting of the snow cover), can bring many complements in all the areas where trees were pulled away.

5. AVALANCHES ON VERY OLD CHALETs IN AREA SUPPOSED TO BE.

Another evidence of the unusual character of certain avalanches is showed by the damages caused, not only on recent houses, but also on very old buildings (hundreds of years), which hadn't undergone such phenomenon so far.

The avalanche on the village of “Valpréveyre” (Figure 2 and figure 4) is surprising because of its South aspect and because of its size and the

importance of the damages it caused. Historically, a small avalanche was repertorised on the CLPA (western part of the village). On December 15th, an avalanche split the village in halves, but nobody was there because it was winter. The damages were noticed by the RTM service only as they were doing a round of inspection of the start zones, on a helicopter, two days later. Two noticeable facts must be underlined: the avalanche started on a South aspect slope, in the path of “Champ Guionet”, at an altitude of about 2150m. With such characteristics, this kind of slope in the Southern Alps is often cleared of snow or at least quickly stabilised during winter under the effect of the Sun radiance and of the relative warmth often observed. The second noticeable fact is the width gradually taken by the avalanche on an only 300m ramp, this way causing big damages. Several houses were damaged by the avalanche and its wind blast. (Cadre) The most striking consequence is the destruction of the 300 years old “Valpréveyre” Chapel. This whole ancestral village is resting against the bottom of a hillside, (notably in order to avoid the torrent's overflowing) considered by the elders as avalanche free.



Figure 2: The chapel destroyed and houses damaged by an unknown avalanche in human memory.

Analysis: a possible cause of the avalanche start could simply be linked to the extra load of new snow, not much cohesive as a whole because of the high intensity snowfalls that had taken place for three days: a snow pillow of 2.5m was measured in Abriès on December 16th. The avalanche started in a steep area (35°), cut across with small rock shelves and planted with scattered larches. All these elements on the slope can create discontinuities in the snow cover, which could limit the start of avalanches able to spread to the whole slope. That's what seems happened here. However, the direct observation couldn't bring to the fore a clear failure in the avalanche start zone.

6. SUPRISING TRAJECTORIES

The avalanche of “la Garcine” (Figure 3 and 4): In human memory, no avalanche had ever been observed as far as in La Garcine, usually more concerned by torrents overflowing. However, important avalanches had already been observed under the crest of Gilly in North Western aspect, but they had never exceeded the altitude of 2000m. This time, no avalanche start was observed under this crest. The wind, mostly from North, stored snow in the southern slopes and the avalanche split into 2 paths in the “Montagne de Varenc” (South- Eastern aspect) in a rather steep zone (about 30°). The right part of the avalanche flowed down the red ski track, causing damages to the ski lifts (pylons and stations) whereas the left part followed the “Garcine” torrent.

The flows finally met at the entry of the Garcine’s path. The avalanche overflowed on the left side and finally reached the village of “La Garcine”, on the torrent’s dejection cone. A chalet was badly damaged on its front and a garden shed was knocked down. Finally, one part of the avalanche kept flowing in the torrent path, following the correction digue of the flowing. The lower part of the avalanche reached the altitude of 1620m.

The striking character of this phenomenon is mostly conveyed by the importance of its size and by the zone affected by its deposit. Despite a very limited area of the start zone, the avalanche flowed down 500 metres more than the former biggest phenomenon.

Considering its South Eastern aspect, the start zone was probably rarely covered with enough snow, or it was quickly stabilised, which limited the risks of avalanches so far. The succession, of big very active “retour d’Est” (The precipitation come from Italy and meet the cold air blocked by France side of the Alps. This creates high snowfall on the border between the two countries) at the beginning of the season is enough to overload the slope and provoke that natural start. The avalanche acquired enough speed, developing a wind blast (as the big forest damages indicate) to cross the gentle slope area uphill from the gorge.

Once it had entered the gorge, the avalanche probably gained some more speed and power considering the land’s steepness (35° and more) and the big quantity of cold snow that was mobilised. These conditions also enabled it to reach the bottom of the slope, to jut out on the left bank of the torrent in a curve and to settle on the projecting ledge of the village of La Garcine. The important snow pillow is also at the origin of avalanches that managed to reach areas that are usually not very exposed, despite the low

ramp. In spite of the little distance covered by the avalanches, the moved mass of snow was important enough to cause the damages on buildings. In mid-December, such phenomenon happened in the area of “Le Vigon” and “des Hoches”, on the hill slopes that dominate Abriès.

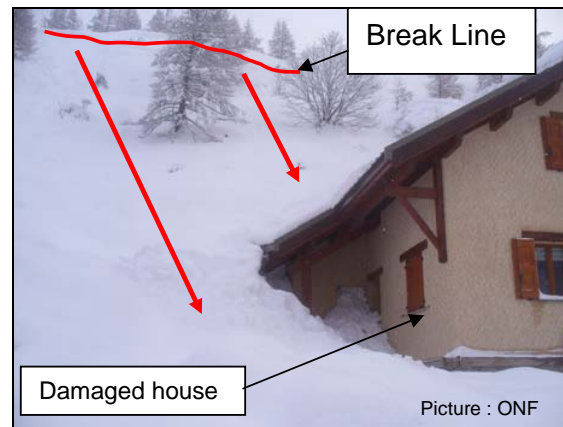


Figure 3: Impacted houses by a small avalanche of only 50 meters of denivellation.

7. TESTIMONY BY THE MAYOR OF THE VILLAGE OF ABRIES, Mrs JOELLE OCANA.

“We are used to the climate phenomena called “retour d’Est”. During the winter season, these phenomena permit us to receive a high amount of snow and when it happens just before the Christmas holidays, it makes us joyful: the season begins so well.

When the snow cover reaches one meter, we can support it, we are used to it. The only problem in this case is to estimate the avalanche danger on the roads. Consequently, we have to preview the avalanche danger and then we decide the road closure. When the danger level is 4 on the scale of 5 degrees (decided by “Meteo France”), the weather forecaster from the Briançon’s office helps us to take decision of the closing of the roads. In this case, we have to inform the local inhabitants to take care of this news and to prepare for consequences. We just hope that the electricity network will be strong enough to support the weather conditions. Then later, the roads are officially closed. We are used to take in charge this kind of situation because for a decade, the debris flows in torrents have been quite frequent, after a relative quiet period for about 50 years. Since 2000, we realised a communal emergency planning used in crisis cases and which permit us to help people during such a period. This tool is very useful for us to orient people and help them while they can feel anxious or panicked. This avalanche crisis could have been assimilated by a debris flows crisis.

On this 15th of December, the weather forecasters of "Meteo France" are preoccupied by a second "retour d'Est", which seems to grow up on the border between Italy and France. We are now beginning to worry about the situation. The amount of snow reaches 2 meters on the ground and it continues to snow heavily. It becomes hard to clear the village of the snow. In the afternoon, fear increases when the phone lines and the electricity network are cut.

On the 16th of December, avalanches never seen in human memory occur on the unique road to evacuate the population. It is really frightening for us because it proves that we are now living an exceptional moment. Around 10 o'clock in the morning, some houses are impacted by an avalanche. In this place of the village, no avalanche had been observed in the local memory and no document (hazard mapping) previously had mentioned such a possible phenomena. Another big avalanche occurred in another area of the village and this event forces us to take the decision to evacuate the village. At the end of the day, everybody is safe while the snow amount reaches 3 meters in the village.

The village becomes isolated while we try to stay in contact with the authorities. The National Forest Office, really implicated in the problems of natural hazards has been really present during the whole period. The implication of those specialists helped us to allow the inhabitants to come back to their house. Still in collaboration with them, we will revise our danger and natural hazards maps".

8. CONCLUSION: WHAT ARE THE TEACHINGS WE MUST REMEMBER IN THE NATURAL HAZARDS ASSESSMENTS.

In the whole panel of events, we had described just a few examples of the major phenomena. Nevertheless, we can notice that the results on the buildings are quite unpredictable and surprising. The biggest avalanches are not especially the most dangerous and it seems clear, after such a period, that every case of avalanche has to be thoroughly studied in for the land use planning. In certain cases, history shows that huge avalanches can spare buildings while the smallest snow slide can create damages on the newest constructions. This proves that the elaboration of the danger maps is really complicated to establish and each avalanche has to be treated.

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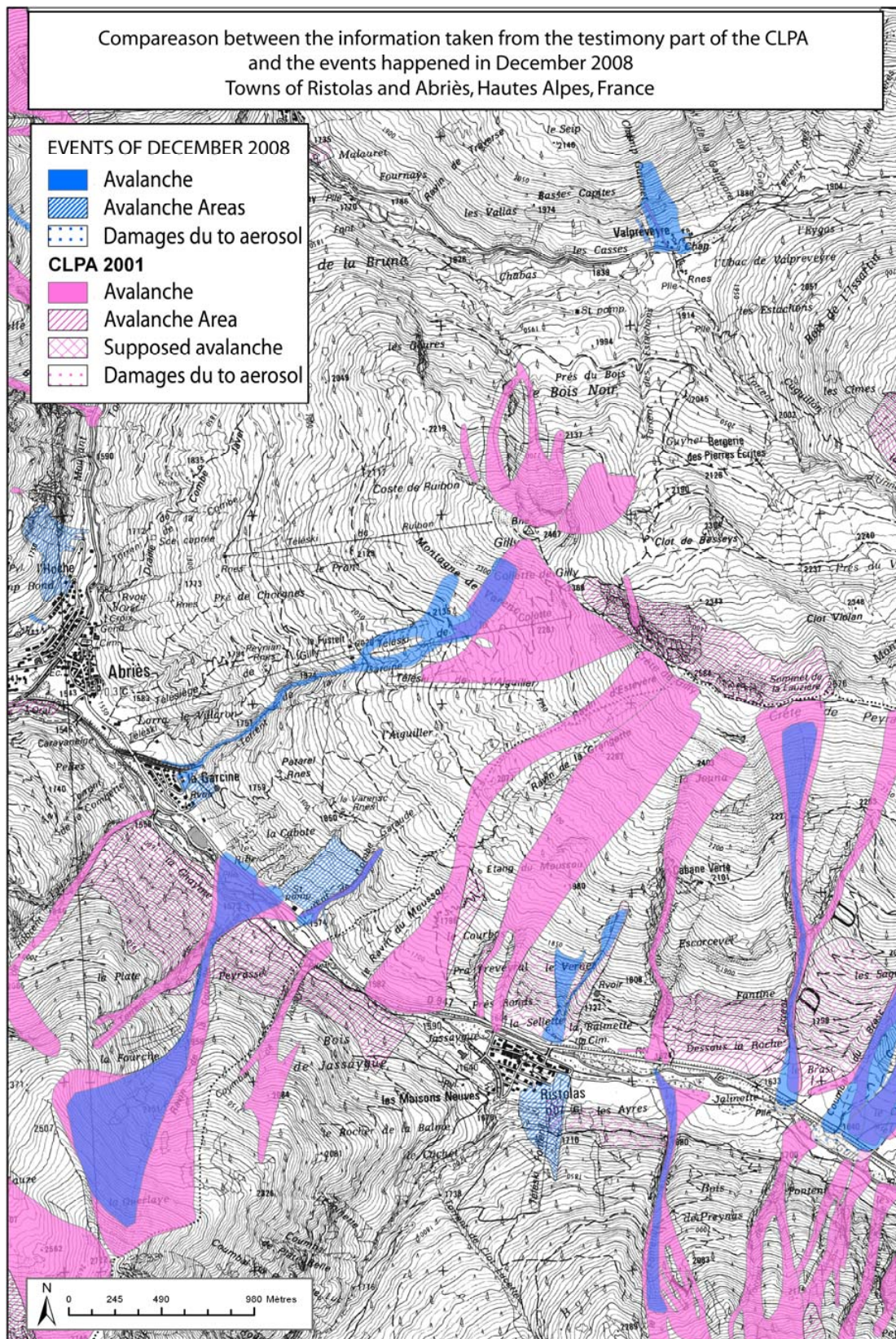


Figure 4: Parts of the towns of Ristolas and Abriès where huge phenomenon occurred during the winter 2008-09