

# Evolution of Public Avalanche Information in North America –

## The New Avalanche Danger Scale<sup>1</sup>

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### **Abstract**

For many years after the introduction of regional avalanche forecast centers in North America, the United States and Canada employed a 4-level avalanche hazard rating system for describing public avalanche danger, the basic components of which were developed in the late 1970's. In contrast, the European avalanche community utilized a variety of public avalanche danger levels from country to country in the 1970's and 80's. To help minimize confusion and allow for better understanding and more uniform dissemination of public avalanche information, a transition toward a "unified 5-level" risk scale was recently undertaken throughout much of western Europe. After much discussion, a 5-level risk/danger/hazard scale evolved in 1993. With some debate Canada adopted this 5-level rating system in 1994, and slightly revised some of the definitions in 1995. In order to accommodate this trend toward an "international unified rating level", the United States avalanche community discussed this potential transition at length during the past year, consulting with Canadian counterparts and hotly debating the merits as well as the definitions of the 5 danger levels. The history of this North American transition toward the 5-level scale, as well as the current accepted danger level definitions for Canada and the United States are presented.

### **Introduction**

Since the 1970's, greatly increasing wintertime usage of public lands outside developed and controlled ski areas has been experienced throughout North America, Europe and indeed much of the world. In order to accommodate an associated need for better avalanche information, and to help promote the safe use of snow-covered mountainous terrain, an expanding body of public avalanche information has evolved throughout many countries where avalanches constitute a significant problem. Recent technological advances along a variety of fronts, ranging from fast and relatively inexpensive computers to increasingly sophisticated remote weather instrumentation and forecast models to enhanced information dissemination systems have also contributed to this evolution of available avalanche information.

Although the form, content and dissemination methods of such public avalanche information has varied widely, an increasing effort has been made to standardize the usage of certain danger levels and basic terminology regarding human exposure to avalanches. Indeed, considerable recent debate has revolved around not only the levels of danger, but how many levels and what their definitions should be. In some regions of the world, the number of avalanche danger levels has ranged from three to as many as seven, with the associated definitions producing further confusion to public users. To add to this, other debate has centered around how best to present the avalanche problem--should avalanche information be given in terms of risk, danger, hazard, instability or potential?

Until relatively recently, a veritable "snow smorgasbord" of avalanche information and danger rating levels existed from country to country and sometimes even within the same country. After much heated discussion and debate throughout Europe, a major shift toward standardizing avalanche risk levels from country to country occurred in the early 1990's, resulting in the five-level "Unified Risk Scale". While still presenting some problems and not agreed upon by all European nations, especially eastern Europe where four danger rating levels are still being used (as of 1995), this unified risk scale has been adopted by most of western Europe and the British Isles. In response to this "international" standard and some meetings with IKAR representatives, Canada adopted the five level scale in the winter of 1994, with some revisions in 1995.

In the United States, a meeting of forecasters from most major avalanche forecast centers in the late-1970's resulted in general usage of a 4-level standard in both the government and private sector throughout most of the

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US. However, with the advent of the "Unified Risk Scale" and its recent adoption by Canada, US forecasters began to consider the merits of changing to this "international" standard in 1995. After much debate and considerable revisions of the definitions of the five levels, the US is planning official adoption of the new avalanche danger rating system in the winter of 1996/97.

Although this transformation toward a quasi-international standard of avalanche danger rating levels is still ongoing, much has been accomplished since the 1970's and much more during the past few years. This paper attempts to outline and discuss this transformation toward a new standard for dissemination of public avalanche information, presenting the evolution from both the American and Canadian experience.

## The United States Experience

### History

In the United States, as late as the early 1970's, some public avalanche bulletins and statements warned of avalanches through terminology like "conditions are about as bad as they can get", and "people should stay out of the mountains until further notice". While information such as this did attract attention and did alert the public to avalanche problems, such messages didn't really educate or teach. There was a definite lack of uniformity, little or no standardized terminology, and often there was no discussion about why avalanches were likely, what travelers could do to minimize their exposure, or when the danger might be abating. In an attempt to address this problem, forecasters with the primary governmental avalanche forecast centers in the United States met in Seattle in 1978 to develop and adopt a standardized set of avalanche "hazard" rating levels and their definitions. After much discussion, the 4-level hazard scheme shown in Table 1 evolved and pretty much formed the basis for organized avalanche forecast or avalanche information operations in the United States through the mid 1980's.

**Table 1. United States Avalanche Hazard Rating System--1978-1996**

WHAT Hazard level, snowpack instability or avalanche potential	WHY	WHAT TO DO
<b>Low</b>	Mostly stable snow exists, and avalanches are <u>unlikely</u> except in isolated pockets on steep, snow-covered slopes and gullies.	Back country travel is generally safe.
<b>Moderate</b>	Areas of unstable snow exist, and avalanches are <u>possible</u> on steep, snow-covered open slopes and gullies.	Back country travelers should use caution.
<b>High</b>	Mostly unstable snow exists, and avalanches are <u>likely</u> on steep, snow-covered open slopes and gullies.	Back country travel is not advised.
<b>Extreme</b>	Widespread areas of unstable snow exist, and avalanches are <u>certain</u> on steep, snow-covered open slopes and gullies. Large destructive avalanches are possible.	Back country travel should be avoided.

As is shown by the table, while US avalanche information centers utilized four levels to describe the degree of avalanche problems, not all used "hazard" to describe that risk. Other terminology such as avalanche potential and snowpack instability was utilized and seemed to provide a good service. Also, normally several statements accompanied any avalanche related forecasts and these took the form of disclaimers (e.g., "these forecasts do not apply to developed ski areas or highways") or additional helpful information to aid forecast usage (e.g., "Note that no matter what the avalanche hazard, there are avalanche free areas in the mountains").

During the mid-late 1980's and early 1990's, however, slight modification of avalanche hazard levels and their definitions occurred from region to region, along with further subtle changes in what was actually being described-hazard, danger, instability, or potential. Forecasters also increasingly found themselves using transitional

categories (like moderate to high) to describe avalanche conditions that exceeded standards described by one level--moderate--but didn't quite meet the agreed-upon definitions for the next higher level--high. In the interest of what was perceived to be more meaningful and less ambiguous to the public, forecasters began to use the term avalanche potential or snowpack instability (functions primarily of the snowpack, weather and terrain) rather than avalanche hazard (previously considered in this context to be a function of nature *and* humans) to describe the dangers due to avalanches. Although four levels remained the de facto standard of public avalanche information, these undercurrents of change within United States avalanche centers continued into the mid-1990's.

Meanwhile, in western Europe and through much of the Alps, public avalanche information and rating levels were topics of heated debate and controversy, as the number of levels and related definitions varied considerably from country to country and from one side of the Alps to the other. This produced significant confusion and difficulty in both dissemination and usage of avalanche information. To address this problem, representatives of much of Western Europe met to resolve these differences and agree upon a standard. A new "International" standard, the so-called "Unified Risk Scale" resulted and is shown below in a slightly modified form (1995). This form resulted after columns describing "Effects on Traffic and residential areas/ recommendations" and "Effects on off-piste and back-country activities / recommendations" were dropped due to lack of general agreement on their usage.

**Table 2. "Modified" European Unified Risk/Hazard Scale (1995, see text for details)**

Degree of Risk or Hazard	Snowpack Stability	Avalanche probability
<b>1. Low</b>	The snowpack is generally well bonded and stable	Triggering is possible only with high additional loads* on a few very steep extreme slopes. Only a few small natural avalanches (sluffs) are possible.
<b>2. Moderate</b>	The snowpack is moderately bonded on some steep slopes, otherwise generally well bonded.	Triggering is possible with high additional loads*, particularly on the steep slopes indicated in the bulletin. Large natural avalanches not likely.
<b>3. Considerable</b>	The snowpack is moderately to weakly bonded on many steep slopes.	Triggering is possible, sometimes even with low additional loads*. The bulletin may indicate many slopes which are particularly affected. In certain conditions, medium and occasionally large sized natural avalanches may occur.
<b>4. High</b>	The snowpack is weakly bonded in most places.	Triggering is probable even with low additional loads* on many steep slopes. In some conditions, frequent medium or large sized avalanches are likely.
<b>5. Very High</b>	The snowpack is generally weakly bonded and largely unstable.	Numerous large natural avalanches are likely, even on moderately steep terrain
<p><b>*NOTES</b>            High additional load--Group of walkers, climbers, skiers            Low additional load--Individual walker, climber, skier</p>		

## The Current State of US Avalanche Information

With the Canadian Avalanche Association (CAA) planning to adopt the new 5-level risk scale in the 1994/95 winter, there was increasing pressure on the American avalanche community (AAAP) to at least consider if not adopt the new "international" standard. At the 1994 ISSW, a well-attended and spirited meeting was held to discuss the pros and cons of the 5-level scale, with representatives from Canada discussing their version of the unified risk scale which was planned for implementation that winter. During this meeting, it was agreed by US representatives that the US should not consider change only because others did. Rather the US viewpoint was to embrace the change only if it made sense in operational forecasting programs, and showed a reasonable chance of actually helping both the forecasters who issued the avalanche products and their users. Additionally, it was the consensus that if five levels made sense, in order for any avalanche danger rating system to work, the definitions of the various levels must be agreed upon first or else there would be no common basis from which to proceed. Hence, after ISSW-94, the major effort focused on crafting definitions (the WHY, WHERE and WHAT TO DO) for five danger/hazard/risk/potential levels which would hopefully meet the needs of most American avalanche professionals.

During the rest of 1994, through much of 1995, and into 1996, revision after revision rose and fell, modified and re-modified on the basis of comments from colleagues both within the US and Canada. Agreement slowly emerged on several general points: 1) KISS (keep it simple, stupid) should be foremost; 2) the danger levels should discuss sensitivity of both human and natural avalanches separately; 2) there should be a continuum in snowpack sensitivity or snowpack instability from the lowest to highest level; 3) changes in areal distribution of a level should be addressed in the context of the forecast and not in the definitions; 4) definitive slope angles should not be used; 5) slab avalanches should be emphasized; 6) what-to-do or recommended action items should be very general; and 7) an avalanche safety basics section should accompany the danger levels to address avalanche awareness in general.

As consensual definitions gradually evolved under these new guidelines during late 1995 and early 1996, it was felt that if these why's, where's and what-to-do's could be agreed upon, then the actual levels of WHAT (low, moderate, .....extreme, etc., and hazard or danger or potential or risk or....) would fall into place more easily. This was both true and false...True that the levels would fall into place, but False in that there would be more controversy on the terms used. The most significant difficulties revolved around what word best described the avalanche problem--be it hazard or danger or risk or instability or potential--and what word should be used for the "infamous transition category" between moderate and high.

As seen in Table 2, the official unified risk/danger scale in use in Europe in 1995 utilized the word *considerable* for the "moderate to high" category, and this term was adopted in Canada as well, although not without some controversy (see Canadian Experience below). Also, while the "official" European scale formally endorsed *danger* when describing the avalanche rating levels, and this word was the choice of the majority of Europe and Canada, in actual practice *risk*, *danger* and *hazard* were also being used, almost interchangeably. The US dilemma was then to find a way to agree on a common term, like *danger*. First, it was felt that the terms like snowpack *instability* or *stability* and avalanche *potential*--while good in describing the actual physical problem--were not universally understood by the public, and were perhaps a step removed from common public awareness. Public perception seemed to relate more closely to *hazard* or *danger* as something that would actually impact them directly. Secondly, when usage of the word *hazard* was closely scrutinized, it seemed that *hazard* was not really what was being forecast. Strictly speaking, the understanding evolved that hazard exists all the time when in avalanche terrain (a consequence of snow and steep slopes), while *danger* more correctly refers to temporal and spatial changes of the magnitude of the *hazard*, changes brought on by such variables as weather, slope angle, aspect, etc. On the other hand, the level of *risk* (actual damage to the individual, rather than the probability of being caught) could be modified significantly by the user through methods chosen to affect his or her exposure to the *danger* (e.g., where the user crossed avalanche paths, what rescue gear the user utilized, etc.). As is obvious the evolution of terminology represented a veritable semantic wonderland. In the end, however, *danger* emerged as the term of choice--familiar to users as something which affected them, and generally accepted by the forecasters who issued the avalanche information.

*Considerable* or a working alternative for the middle rating level category between moderate and high presented another big challenge. Solicitation of suggestions from any avalanche forecaster possessing a dictionary, thesaurus or good grasp of English produced few workable choices other than the obvious--*moderate to high*. The word chosen needed to not only be meaningful in a stand-alone context for statements discussing current avalanche danger ("The avalanche danger today is *considerable*"), but also meaningful in the context of a forecast when the

danger was expected to change from one level to another ("High avalanche danger Tuesday morning, decreasing and becoming *considerable or moderate to high* Tuesday afternoon and night.....etc.). Although some initial confusion over the meaning of *considerable* was apparently overcome in Canada (see the Canadian Experience), the word was still considered to be somewhat ambiguous by some US forecasters. Questions like "isn't there a considerable avalanche problem when the danger is high?", "does a change from high to considerable really imply a decrease?", and "why not just say what you mean, moderate to high?" encouraged the US adoption of "*moderate to high*" as the official replacement (at least for the time being) for *considerable*. The end result of all this discussion about a grand variety of possibilities to describe levels of avalanche danger is summarized below in Table 3.

**Table 3. United States Avalanche Danger Scale (1996)**

<b>AVALANCHE SAFETY BASICS</b>			
<p>Avalanches don't happen by <u>accident</u> and most human involvement is a matter of <u>choice</u>, not chance. Most avalanche accidents are caused by <u>slab</u> avalanches which are triggered by the victim or a member of the victim's party. However, <u>any</u> avalanche may cause injury or death and even small slides may be dangerous. Hence, always practice safe route finding skills, be aware of changing conditions, and carry avalanche rescue gear. Learn and apply avalanche terrain analysis and snow stability evaluation techniques to help minimize your risk. Remember that avalanche danger rating levels are only general guidelines. Distinctions between geographic areas, elevations, slope aspect and slope angle are approximate and transition zones between dangers exist. No matter what the current avalanche danger there are avalanche-safe areas in the mountains.</p>			
<b>United States Avalanche Danger Descriptors</b>			
<b>Danger Level</b> (& Color)	<b>Avalanche Probability and Avalanche Trigger</b>	<b>Degree and Distribution of Avalanche Danger</b>	<b>Recommended Action in the back country</b>
<b>...WHAT...</b>	<b>.....WHY.....</b>	<b>.....WHERE ....</b>	<b>..WHAT TO DO...</b>
<b>LOW</b> (green)	Natural avalanches very unlikely. Human avalanches <u>unlikely</u> .	Generally stable snow. Isolated areas of instability.	Travel is generally safe. Normal caution advised.
<b>MODERATE</b> (yellow)	Natural avalanches unlikely. Human triggered avalanches <u>possible</u> .	Unstable slabs <u>possible</u> on steep terrain.	Use caution in steeper terrain on certain aspects (defined in accompanying statement).
<b>MODERATE to HIGH</b> (orange)	Natural avalanches possible. Human triggered avalanches <u>probable</u> .	Unstable slabs <u>probable</u> on steep terrain.	Be increasingly cautious in steeper terrain.
<b>HIGH</b> (red)	Natural and human triggered avalanches <u>likely</u> .	Unstable slabs <u>likely</u> on a variety of aspects and slope angles.	Travel in avalanche terrain is not recommended. Safest travel on windward ridges of lower angle slopes without steeper terrain above.
<b>EXTREME</b> (red with black border)	Widespread natural or human triggered avalanches <u>certain</u> .	Extremely unstable slabs <u>certain</u> on most aspects and slope angles. Large destructive avalanches possible.	Travel in avalanche terrain should be avoided and travel confined to low angle terrain well away from avalanche path run-outs.

## The Canadian Experience

### History And Current State Of Avalanche Information

When Peter Schaerer came back from the International Commission of Alpine Rescue (IKAR) meeting in 1993 he brought a present for the North American avalanche community. Like many surprise gifts it turned out being more immediately useful to some people than others. The Canadian Avalanche Centre (CAC) needed little encouragement to use the scale as the Avalanche Bulletin had only recently started and had been skirting around the issue of talking about level of hazard or danger. This was partly due to a slowly building confidence in reporting anything other than reported weather, snow and avalanche conditions. The Bulletins prepared by the CAC were not *forecasts*. In Canada the two major organizations preparing avalanche information for the public used different terminology--in the case of National Parks and Kananaskis Country, one used stability ratings, the other hazard. At the Centre, in a good Canadian fashion we did not want to take sides so the introduction of a *danger* scale was well timed and appropriate for consistency with our IKAR colleagues. A memorable meeting was held at Rogers Pass in the summer of 1994 and it was decided that all Canadian agencies would use the *danger scale*.

But let us step back a moment about the larger reasons why we needed to introduce the "unified scale". Basically this was undertaken to: 1) eliminate confusion; 2) allow for better understanding; and 3) provide for more uniform dissemination of information.

So why should we do this? In Europe and in particular and increasingly in North America travelers in avalanche terrain are going into all the states and provinces. It is confusing for those users of avalanche information to have different types of Bulletin/Forecast/Information in every area they go. And it begs the question of the user, "why are these bulletins so different, do any of them know what they are talking about?" Credibility then becomes an issue.

As in the United States, there was much debate in Canada about the descriptors for the levels of avalanche danger. And this has been most recently addressed again by Walter Bruns. As a result there will be refinements that will be introduced this winter, and the current planned Canadian Avalanche Danger Rating System is shown below in Table 4.

But the most contentious issue has been the use of one word: CONSIDERABLE.

While the Canadian avalanche community had gone ahead with the introduction of the danger scale in Canada we had rather naively and in blessed ignorance not consulted with our good neighbors to the south. This led to a diplomatic exchange of notes between the Presidents of the American Association of Avalanche Professionals (AAAP) and the Canadian Avalanche Association (CAA) and an even more memorable meeting in a small hotel room during the last ISSW that was referred to earlier. Now the issue had come out of the closet.

Canadians have used the word for the past two winters. For the public and the users of the Bulletin it has achieved a good level of acceptance and understanding and is clearly a word that cannot be confused with any combination of words. The news media, who although we may often criticize their description of avalanche events are ultimately the primary communicator with the best resources to disseminate information are using the *considerable* word. It is used by the radio, television, and print media. The widest distribution of avalanche information on television and radio is usually when the danger is high or extreme but occasionally circumstances see widespread use of the word *considerable*.

Finally and perhaps most importantly is the public, the traveler in the mountains, how do they find it? Certainly in the first season we had some inquiries, literally a hand full. We have on file now a record of communication and comments from people who like the new scale. We, the providers of this avalanche information must not forget who we serving. That is not to say we must compromise our professional and technical standards but the use of this word does not do that.

### Summary

We have come a long way in a relatively short time. Much of the progress made has resulted from a spirit of international cooperation, the work of many dedicated professionals and the goal of increasing public safety by having good avalanche information available in a consistent format across international boundaries. While we may

not have arrived at the best possible avalanche rating system for all time, it is the best for now and will hopefully serve both the forecasters and the public that use it well.

## **Acknowledgements**

Much of the work here would not have begun without the initial steps taken by IKAR and the European avalanche community, who had a much more daunting and formidable task than ours. The current United States Avalanche Danger Rating System would not have been possible without the help of a great many American avalanche professionals, people like Bruce Tremper, Knox Williams, Chris Landry, Dale Atkins, Doug Fesler, Jill Fredston, Karl Birkeland, Ron Johnson, Ken White, Garth Ferber and Kenny Kramer. The USDA-Forest Service, the Washington State Department of Transportation, the National Park Service and all the other cooperators of the NWAC should also be acknowledged for their support in allowing me time to address this issue. And the joint evolution of the American and Canadian systems to coalesce as closely as they are now would not have succeeded without compromise, suggestions and critiques from many Canadian avalanche professionals like Alan Dennis, Jack Bennetto, Clair Israelson and Dave McClung. Many others, both in the US and Canada, lended their support and ideas and I greatly appreciate it. Despite all the multitude of iterations that this process involved, I think we all learned a great deal, no, make that a *considerable* amount, from it.

—Mark Moore

I would like to thank George Field and Clair Israelson who are the other two members of the CAA Public Safety Committee. They initially laid down arms on this issue in Canada to introduce the scale. In an earlier presentation at this ISSW, other information has been presented about the Avalanche Bulletin prepared by the CAC. We are excited about the level of acceptance it has achieved, for every regional avalanche knows the most important work we do is the preparation of these products. It's a fact that although there has been a tremendous increase in the use of avalanche terrain there has not been a corresponding increase in fatalities. Let's hope this is a sign that the Forecasts and Bulletins put out by all the regional operations has helped in that trend....and finally, Peter Schaerer, thank you for the gift.

—Alan Dennis