

Appendix G

Avalanche Danger, Hazard, and Snow Stability Scales

G.1 Introduction

There are many ways to communicate the current avalanche conditions. Categorical scales of avalanche danger, avalanche hazard, and snow stability can improve communication between forecasters and customers. Forecasting operation managers should select an appropriate scale based on the definitions that follow. The scales presented in this appendix are examples of commonly used communication methods.

G.2 Definitions

Stability

The chance that avalanches *do not* initiate. Stability is analyzed in space and time relative to a given triggering level or load.

Exposure— An element or resource (person, vehicle, structure, etc...) that is subject to the impact of a specific natural hazard.

Hazard, Avalanche—The potential for an avalanche(s) to cause damage to something of value. It is a combination of the likelihood of triggering and the destructive size of the avalanche(s). It implies the potential to affect people, facilities or things of value, but does not incorporate vulnerability or exposure to avalanches. Avalanche danger and hazard are synonymous and are commonly expressed using relative terms such as high, moderate and low.

Risk— The chance of something happening that will have an impact on an element (person, vehicle, structure, etc...). A risk can be often specified in terms of an event or circumstance and the consequences that may follow. Risk is evaluated in terms of a combination of the consequences of an event and its likelihood.

Vulnerability— The degree to which an exposed element (person, vehicle, structure, etc...) is susceptible the impact of a specific natural hazard.



Figure G.1 Vegetation damage from a large avalanche (photograph by John Stimberis).

G.3 General Guidelines for the use of Avalanche Conditions Scales

Avalanche conditions within a forecast area can be separated based on terrain or snowpack characteristics.

Specify the area based on:

- Elevations
 - Numerical range
 - Geographic feature (i.e. Alpine, Treeline, Below Treeline)
- Aspect
- Slope angle
- Specific conditions such as wind loaded slopes or depth of new snow
- Spatial extent (localized or widespread)
- Time of day

Note: Timberline (treeline) describes a transition area between closed forest and the open treeless areas above.

Where practical give the expected stability trend for the next 12 to 24 hours. Use the terms: improving, steady, and decreasing stability to describe the trend.

Specify a confidence level in the ratings when appropriate; describe sources of uncertainty in forecast. Note the level of the unstable layer in the snowpack (i.e. near surface, mid level, deep).

Observers may qualify the rating based on:

- Topography (aspect, slope angle, etc.)
- Spatial extent (localized or widespread)
- Time of day



Figure G.2 Widespread avalanche activity within a single drainage (photograph by Craig Sterbenz).

G.4 Snow Stability Scale

Stability refers to the chance that avalanches will *not* initiate, and does *not* predict the size or potential consequences of expected avalanches. Stability scales are sometimes used operationally in combination with variables such as slope aspect, elevation, and temporal effects. The Avalanche Danger Scale (Section G.5) is the preferred method for communicating avalanche conditions to the public.

Note: Statements about avalanche activity take precedence over results of stability tests.

For regional and larger forecast areas, isolated natural avalanches may occur even when stability for the area as a whole is good.

Table G.1 Snow Stability Rating System

Stability		Expected Avalanche Activity		
Stability Rating	Comment on Snow Stability	Natural Avalanches <i>(excluding avalanches triggered by icefall, cornice fall, or rock fall)</i>	Triggered Avalanches <i>(including avalanches triggered by human action, icefall, cornice fall, rock fall or wildlife)</i>	Expected Results of Stability Tests
Very Good (VG)	Snowpack is stable	No natural avalanches expected	Avalanches may be triggered by very heavy loads such as large cornice falls or loads in isolated terrain features	Generally little or no result
Good (G)	Snowpack is mostly stable	No natural avalanches expected	Avalanches may be triggered by heavy loads in isolated terrain features	Generally moderate to hard results
Fair (F)	Snowpack stability varies considerably with terrain, often resulting in locally unstable areas	Isolated natural avalanches on specific terrain features	Avalanches may be triggered by light loads in areas with specific terrain features or certain snowpack characteristics	Generally easy to moderate results
Poor (P)	Snowpack is mostly unstable	Natural avalanches in areas with specific terrain features or certain snowpack characteristics	Avalanches may be triggered by light loads in many areas with sufficiently steep slopes	Generally easy results
Very Poor (VP)	Snowpack is very unstable	Widespread natural avalanches	Widespread triggering of avalanches by light loads	Generally very easy to easy results

Definitions / Examples

- Natural avalanches: Avalanches triggered by weather events such as snowfall, rain, wind, temperature changes, etc.
- Heavy load: A cornice fall, a compact group of people, a snowmobile or explosives.
- Light load: A single person, or a small cornice fall.
- Isolated terrain features: Extreme terrain; steep convex rolls; localized dispersed areas (pockets) without readily specifiable characteristics.
- Specific terrain features: Lee slopes, sun-exposed aspects.
- Certain snowpack characteristics: Shallow snowpack with faceted grains, persistent weaknesses, identified weaknesses.

G.5 Avalanche Danger Scale

The Avalanche Danger presented in this section is used by regional avalanche forecast centers in the United States. The scale was designed to facilitate communication between forecasters and the public. The categories represent the probability of avalanche activity and recommend travel precautions.






North American Public Avalanche Danger Scale				
Avalanche danger is determined by the likelihood, size and distribution of avalanches.				
Danger Level		Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme (black)		Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High (red)		Very dangerous avalanche conditions. Travel in avalanche terrain <u>not</u> recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable (orange)		Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate (yellow)		Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low (green)		Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.
Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.				

Figure G.3 The North American Public Avalanche Danger Scale (Statham et al., 2010).

Table G.2 Color Standards for the North American Public Avalanche Danger Scale

Danger Level	CMYK	RGB	WEB
5 Extreme	(0, 64, 100, 100)	(35, 31, 32)	231F20
4 High	(0, 100, 100, 0)	(237, 28, 36)	ED1C24
3 Considerable	(0, 50, 100, 0)	(247, 148, 30)	F7941E
2 Moderate	(0, 0, 100, 0)	(255, 242, 0)	FFF200
1 Low	(70, 0, 100, 0)	(80, 184, 72)	50B848

G.6 Avalanche Hazard Scale

Avalanche hazard scales can be used when forecasting the threat of avalanches to structures and transportation arteries. The scale should be tailored for each individual operation. Table G.3 contains a scale used by the Colorado Avalanche Information Center/Colorado Department of Transportation. This scale is presented as an example of an operational avalanche hazard scale.

Table G.3 Avalanche Hazard Scale

Hazard Level	Description	Operational Impact
None	Insufficient snow for avalanches to reach the highway.	Normal highway operations.
Low	Mostly stable snow. Natural avalanches are unlikely to affect the highway. Small triggered and natural avalanches are possible.	Normal highway operations.
Moderate	Areas of unstable snow. Natural and triggered avalanches possible. A moderate amount of snow on the highway is possible.	Normal highway operations continue with caution. Explosive mitigation may be necessary.
High	Mostly unstable snow. Natural and triggered avalanches across the highway are likely. A moderate to large amount of snow on the highway is possible.	Highway closure may be necessary. Explosive mitigation will be required. Maintenance and emergency traffic may continue prior to avalanche control if hazard and need warrants.
Extreme	Widespread unstable snow. Natural and triggered avalanches certain. A large amount of snow on the highway is likely.	Highway closure necessary until explosive mitigation completed.



Figure G.4 An explosive triggered avalanche strikes Colorado Highway 160 near Wolf Creek Pass (photograph by Mark Mueller).

