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WSL Institut pour l'étude de la neige et des avalanches SLF
WSL Institute for Snow and Avalanche Research SLF
WSL Istituto per lo studio della neve e delle valanghe SLF

Avalanche Bulletin Interpretation Guide

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The avalanche bulletin

The WSL Institute for Snow and Avalanche Research SLF uses the avalanche bulletin and various supporting products to inform the public about the current snow and avalanche situation in the Swiss Alps and in the Jura. The content of the avalanche bulletin is designed as an informed warning. It is published twice daily in winter and primarily contains a forecast of the avalanche danger in the Swiss Alps, Liechtenstein and, when there is sufficient snow cover, the Jura as well.

Additional information about the weather's effects in terms of avalanches and the condition of the snowpack gives users a clearer picture of the current situation and provides a basis for making their own assessment, as the information provided the avalanche bulletin cannot take the place of their own local on-site assessment. The information contained in the bulletin is too general for this because of the limited data it is based on.

Target audience

The avalanche bulletin is aimed at all those who are exposed to potential avalanche danger in the mountains in winter, whether in a professional or recreational capacity, and those who are responsible for the safety of others. This includes members of the following groups:

- Avalanche services and committees of the communal authorities and civil engineering offices, as well as the safety services of the mountain railway/cableway operators
- The police and rescue services and the armed forces
- Mountain guides, snow sports instructors and backcountry tour guides
- Residents of mountain villages
- Winter sports enthusiasts away from secured ski runs, such as freeriders, backcountry skiers, snowshoe hikers, mountaineers and ice climbers

When the snow and avalanche situation is relatively favourable, the avalanche bulletin will mainly contain information for winter sports enthusiasts. From danger level 3 (considerable) upwards, information for the avalanche warning services is issued more frequently. At the very high avalanche danger level (level 5), when snow sports are hardly possible anyway, the avalanche bulletin will mainly contain information for the avalanche warning services.
Structure of the avalanche bulletin

In high season the structure of the avalanche bulletin is based on the 'information pyramid', i.e. the most important comes first (danger level), followed by details of the locations where the danger is particularly significant and then the avalanche problem, the danger description and information about the snowpack and the weather. Finally, measured data can also be displayed. The use of standardized terminology aids both understanding and implementation.

Individual parts of the avalanche bulletin

In winter, the avalanche bulletin consists of a zoomable hazard map, including a hazard description and a section headed "Snowpack and weather". A description of this content is given below. Less information is usually provided in off-peak season and in case there is a lot of snowfall in summer. In those periods the avalanche bulletin is published in plain text format, with no hazard map and usually no danger levels.

Flash

The flash section is a very brief pointer to the key aspects of the avalanche situation.

Avalanche danger

The avalanche bulletin's most important component is its avalanche danger forecast. This comprises the following aspects:

Danger level and avalanche prone locations

The danger level is described with reference to the five-point European avalanche danger scale and, in most cases, the endangered aspects and altitude zones are pinpointed as well. If such
information is not given, the indicated danger level applies to all aspects and altitude zone. Warning regions are grouped together where an identical danger level applies in identical aspects and altitude zones, provided that the avalanche problems are also identical and the danger can be described appropriately for all the affected regions. The danger description may contain additional information concerning terrain types that are particularly affected.

The danger level and, if possible, the aspects and altitude zones where the danger level applies, are depicted in a hazard map.

If the danger level is likely to change during the day, the danger level is normally based on the situation in the morning. In typical springtime conditions, two maps show both the more favourable morning situation (dry-snow avalanches) and the more unfavourable situation in the afternoon (wet-snow avalanches as the day progresses) (double map).

**Avalanche problems**

Often the avalanche danger is classified as falling under one or more of the five 'typical avalanche problems'. Normally the avalanche bulletin assigns the situation to one or more of these categories. The following problems are distinguished:

- New snow (considerable snowfall in recent days)
- Wind slabs (snow transported by the wind)
- Old snow (weak layer(s) prone to triggering within the old snowpack)
- Wet snow, in which case a distinction is made between:
  - Wet-snow avalanches
  - Wet-snow avalanches as the day progresses
- Gliding avalanches

If there is no conspicuous avalanche problem (often when a low avalanche danger (level 1) applies), the situation is described with the text "no distinct avalanche problem".

**Danger description**

There is a specific danger description for each danger region marked on the map. It describes the conditions in the altitude zones and aspects where the danger level applies. Outside these altitude zones and in other aspects it can be assumed that a fundamentally similar avalanche situation exists. Here, however, the avalanche prone locations are likely to be found less frequently. Among other factors, the danger description can contain information concerning the likelihood of release and the size of the anticipated avalanches, or relating to the snowpack structure. If necessary, remarks or recommendations for individual groups of users will also be provided.

**Additional danger:** If necessary, the description of the main danger can be followed by an additional danger, for example both dry-snow and wet-snow avalanches being expected. Apart from the absence of a graphical representation of the particularly affected aspects and altitudes, the additional danger is written up in the same way as the main danger. If the description of the additional danger does not state a danger level, the applicable level is often one lower than the level that applies to the main danger described in the hazard map. In double maps, each hazard map will only show the main danger.

**Remarks:** The 'Remarks' field at the end of the danger description can be used to pass on additional information to users, e.g. about an additional source of danger or a particularly uncertain weather outlook.
**Snowpack and weather**

This part of the avalanche bulletin is only updated in the evening and is made up of the following parts:

**Snowpack**

The snowpack is the principal determining factor in the formation of avalanches. A general description is given, usually covering both the layering of the snow and the stability. While snow layering is determined by the stratification of the snowpack and the structural properties of its individual layers (grain shape and size, hardness), the snow layering is crucial to snowpack stability. This section also describes the observed avalanche activity if applicable.

**Weather**

The weather affects the snowpack and therefore how the avalanche dangers develop. Key factors for avalanche danger such as fresh-fallen snow (or rain), air temperature and wind are set out. The description begins with a review of the weather conditions in the immediately preceding period (covering at least the current day), which is followed by the forecast for the validity period of the avalanche bulletin. The danger assessment is formulated on the basis of this weather forecast. If locally the weather until that time has deviated from that described or the actual weather pattern differs from the forecast, this may also affect the anticipated avalanche danger.

**Outlook**

Based on the medium-term weather forecast, the indicative outlook evaluates the general pattern of the avalanche danger for the two days immediately after the bulletin's validity period.

**Recommendations**

In addition to the danger assessment, the avalanche warning service frequently also issues recommendations. These are generically defined in the danger scale but can also form part of the danger description and be addressed to specific groups of users. These are of course recommendations, not rules. After making his or her own evaluation of the situation on site, the decision as to how to respond to the avalanche danger and what risks he or she is willing to take rests with each individual.

Recommendations for transport routes and settlements are sent to those responsible for the cantonal and communal avalanche warning services, roads, railways, mountain railways/cableways and secured ski runs. 'Safety measures' include avalanche blasting, closure of transport routes, slopes or ski runs, or, in particularly critical conditions, searching for shelters or evacuation routes from individual locations or entire community zones. The safety measures to be taken in a specific situation vary from case to case and are determined by those responsible for public safety.

Recommendations for individuals outside secured areas are especially aimed at snow sports enthusiasts away from secured ski runs, for example freeriders, backcountry skiers, snowshoe hikers, ice climbers and mountaineers. 'Conditions' refers solely to avalanche danger, not to the amount of snow, snow conditions (powder snow, breakable crust) or weather conditions (fog, storm) even if these may sometimes pose a potential threat. 'Experience' always means experience in assessing avalanche danger. This is ideally acquired under expert guidance, e.g. in avalanche courses or on guided backcountry tours or off-piste activities.
Products

In winter, the avalanche bulletin consists of an interactive map, including danger descriptions and a section headed "Snowpack and weather". In low season the avalanche bulletin appears in plain text format in the event of heavy snowfall.

Interactive avalanche bulletin

The internet and smartphone versions of the interactive avalanche bulletin consist of two parts:

Hazards map, including danger description:

The danger description is based directly on the zoomable hazard map. As users move their mouse over the hazard map, the individual regions are highlighted. Clicking the map opens a window containing the relevant danger description. During the winter, the hazard map and danger descriptions are updated twice a day, at 8 am and 5 pm.
Snowpack and weather

The description of the snowpack, weather and outlook for the following days is only updated in the evening.

Print versions of the avalanche bulletin

Various versions of the avalanche bulletin are available in .pdf format for printing. They are published at the same time as the interactive avalanche bulletin and feature exactly the same content. The following print versions are available:

- Full avalanche bulletin: This has the same content as the interactive avalanche bulletin: hazard map, danger description for all regions, and the 'Snowpack and weather' section.
- Regional hazard maps: Hazard map of a climate region with a description of the selected danger region. Ideal for display in freeriding regions. (Bernese and Fribourg Alps, central sector of the northern flank of the Alps, Lower Valais and Vaud Alps,

The "Snowpack and weather" section is published in German at 5 pm and in the other languages by 6 pm at the latest.
Upper Valais, Northern and Central Grisons, Ticino und Moesano, Engadine and southern valleys, Jura

- Individual danger regions: Hazard map of Switzerland including danger description for the selected danger region
- Hazard map of Switzerland: only a hazard map, with no danger description
- Snowpack and weather: description of the snowpack, weather and outlook for the following days

**Considerable avalanche danger will be encountered in some regions**

**Edition: 27.7.2017, 08:00 / Next update: 27.7.2017, 17:00**

**Level 3, considerable**

**Wet avalanches as day progresses**

Avalanche prone locations

![Avalanche prone locations diagram]

**Danger description**

A clear night will be followed in the early morning by favourable conditions for a short time, but the danger of wet avalanches will increase later. As a consequence of warming during the day and solar radiation a large number of small and, in isolated cases, medium-sized full-depth and wet avalanches are to be expected. This applies in particular on steep south-facing slopes above approximately 2800 m. In particular on steep, little used shady slopes, avalanches can penetrate down to the ground and can reach as far as intermediate altitudes. Backcountry tours, off-piste skiing and ascents to alpine cabins should be started very early and concluded timely. Careful route selection and spacing between individuals are recommended. The current avalanche situation calls for experience in the assessment of avalanche danger and careful route selection.

**Snow drifts**

The somewhat older snow drift accumulations can be released by a single winter sport participant in some cases in particular on extremely steep shady slopes.

**Danger levels**

Icons

Icons provide an initial overview of the avalanche danger.

Icon map

An icon map is a generic hazard map showing only the danger level. If separate hazard maps have been published for the morning and for the afternoon (double map), there will still only be one icon map, indicating the highest danger facing each danger region.

The icon maps can only be consulted in the archive.

An icon map is a generic hazard map showing only the danger level.

Individual icons

The SLF makes icons with the current danger level available to various third parties. They are used, for example, in weather and tourism websites to provide quick information about the avalanche danger and a link to the avalanche bulletin. The following icons are used:

<table>
<thead>
<tr>
<th>Danger level</th>
<th>Danger of wet snow avalanches - increasing avalanche danger during the day</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Very high</td>
<td>![Icon for Very High Danger]</td>
</tr>
<tr>
<td>4 High</td>
<td>![Icon for High Danger]</td>
</tr>
<tr>
<td>3 Considerable</td>
<td>![Icon for Considerable Danger]</td>
</tr>
<tr>
<td>2 Moderate</td>
<td>![Icon for Moderate Danger]</td>
</tr>
<tr>
<td>1 Low</td>
<td>![Icon for Low Danger]</td>
</tr>
<tr>
<td>no danger level</td>
<td>![Icon for No Danger Level]</td>
</tr>
</tbody>
</table>

Icons for the various danger levels are standardized throughout Europe.
Bulletin in plain text format

From early summer until autumn in case of heavy snowfall, an avalanche bulletin is published in plain text format. As at that time of the year there is a low volume of field data available, it is often impossible to give a danger level. Bulletins in plain text format are published in German at 5 pm, while the translations (French, Italian and English) are published by 6.30 pm at the latest.

Notifications of unscheduled avalanche bulletins can be provided by a push alert on the White Risk app.

Bulletins in plain text format are mainly published when there is an insufficient volume of data available for an assessment involving danger levels.

Supporting products

In addition to the avalanche bulletin, the SLF publishes many supporting products such as snow maps and weekly and annual reports. Details of these can be found with the relevant products.

Media used

The SLF uses various media to provide information on the current snow and avalanche situation in Switzerland and Liechtenstein.
www.slf.ch
The avalanche bulletin, snow maps, measured values at the measuring stations and weekly and annual reports as well as the full descriptions of these products are published on the SLF website.

With RSS Feeds you can stay up to date with the publication of new avalanche bulletin.

White Risk
With the SLF's free White Risk app, you can quickly and easily consult the avalanche bulletin, the snow maps and the measured values at the measuring stations when you are on the move. Push alerts notify you of unscheduled bulletins (an additional bulletin in the winter, an avalanche bulletin in summer as a result of the situation) and other important information relating to the avalanche bulletin. The app is available in four languages (German, French, Italian and English) from the iTunes App Store (for iPhone) or Google Play Store (for Android).

The app also features background knowledge about avalanches, and tools for use in the field. If you also want to use the backcountry tour planning section of the app, you will need to purchase a White Risk licence on the website www.whiterisk.ch.

Radio
In the winter months, SRF 1 broadcasts interviews about the avalanche situation at 4:50 pm each day. Such interviews are also broadcast on many other radio stations in particular just prior to the weekend or in case of increased avalanche danger. In Italian-speaking Switzerland the interviews are organised in cooperation with MeteoSwiss.

Television
SRF 1, SRF info, RTS, RSI: During each channel's weather forecasts shortly before or shortly after 8 pm. Often on Fridays, but occasionally on other days as well. In particular when there is an increased avalanche danger.

Natural Hazards portal
The MeteoSwiss app and www.natural-hazards.ch provide an overview of the natural hazards situation in Switzerland. They show the danger levels for all the natural hazards for which warnings are issued (rain, thunderstorms, floods, snow, avalanches, heat wave, frost, slippery roads, wind, forest fires, earthquakes) and provide general information about the individual hazards and how to respond to them. The information for this is supplied by the Swiss federal government's natural hazard agencies, namely the Federal Office of Meteorology and Climatology (MeteoSwiss), the Federal Office for the Environment (FOEN), the WSL Institute for Snow and Avalanche Research SLF, and the Swiss Seismological Service (SED).

Social media
The avalanche warning service posts messages on Instagram, Facebook and Twitter with the identifier whiteriskslf. The posts complement the information published at slf.ch and in the WhiteRisk app, but do not replace it.

You can help us to process information methodically and quickly by reporting observations relating to the avalanche situation or accidents not via social media, but with the WhiteRisk app or by way of our website.
Publication times and validity

Winter
In winter, the avalanche bulletin is published twice a day. It consists of two parts:

**Avalanche danger (hazard map, including danger description)**

- 5 pm edition: forecast of the avalanche danger until 5 pm the next day (in four languages)
- 8 am edition: forecast of the avalanche danger until 5 pm the same day (in four languages)
- In principle, an assessment of the avalanche danger at other times is also possible, but only very occasional use is made of this possibility.

**Snowpack and weather**

- 5 pm edition in German, applying until 5 pm the next day
- The translations (into French, Italian and English) will be available by 6 pm at the latest.

**Early and late winter season**
In early winter (typically from November to early December) and late spring (typically from late April to May) the avalanche bulletin is only published in the evening. The format and content are the same as in winter. The bulletin may cover a period of several days, running

**Summer and autumn**
From early summer until autumn, avalanche bulletins are published in case of heavy snowfall, and in late autumn at other times as well if the snow cover warrants it. As in this period the volume of on-site data available is less than in mid-winter, these are plain-text bulletins with no hazard maps and also generally no danger levels. They may cover a period of several days, running until 5 pm on the final day.

- Edition in German published at 5 pm
- The translations (into French, Italian and English) will be available by 6:30 pm at the latest.

The criteria for the publication of a summer avalanche bulletin are met if the forecast depth of fresh-fallen snow per precipitation occurrence (normally 1 – 3 days) reaches one of the following values:

- 20 cm at 2000 m or
- 40 cm at 2500 m or
- 60 cm at 3000 m or
- 80 cm at 3500 m

These values are only intended as a guideline. Whether a bulletin is actually published also depends on the wind, the temperature and the spread and characteristics of the existing snowpack. Furthermore, the snowfall event must affect at least one whole massif; local snow flurries caused for example by individual thunderstorm cells do not count towards this.
Resources
The avalanche warning service has a wide range of data at its disposal, including measurements, observations, assessments and model results. Only the interplay between them ensures that the avalanche bulletin is as reliable as possible in all the different situations that can occur.

Measurements
With a view to producing the avalanche bulletin and also for climatological and hydrological purposes, the SLF operates an extensive network of measuring stations. This is set out in more detail on the following pages for the current measured values:

- Current measured values
- Network of automated measuring stations
- Network of manual measuring sites

Observations and assessments
Current field data are required to ensure that users can rely on the bulletins, which is why the SLF maintains its own network of observers. The official observers are trained by the SLF, report regularly on their findings and get paid for their reports. Different data may be collected depending on the situation, including for example estimates of fresh-fallen snow and fresh snowdrift, observed alarm signals and avalanches and often also an assessment of the current avalanche danger.

Additional information comes from local safety services, rescue organisations and the police and also of course from winter sports enthusiasts.

Reports to the avalanche warning service from the field in winter 2019/20. The large circles indicate where daily observations were reported. Only a small number of observations originate in the high Alpine regions, the Prealps and the regions south of the main Alpine ridge. In these places the avalanche situation should be examined especially thoroughly in the field (see "Capabilities and limitations of the avalanche bulletin").
SLF observers

Some of the SLF observers generally file their reports from one and the same region, which is usually the place where they live or work. Some of these perform measurements at a measuring site as well as providing observations. If possible, these observers report their findings daily throughout the winter, thereby providing basic data coverage for the area in question. The reports are submitted between 6 and 8 am, or in the middle of the day.

Mobile SLF observers

Other SLF observers move freely within the territory of the Swiss Alps. They submit their reports whenever they have information of interest from their respective location.

Public reporting

The extent of the Swiss Alps and regional differences mean that the official observers can never cover everything. As a result, the avalanche warning service also relies on reports from private individuals. Therefore, we would like to encourage everyone to submit their own observations – thank you very much!

Time permitting, the avalanche forecasters also search other platforms such as www.bergportal.ch and www.camptocamp.org for avalanche information.

Avalanches

In addition to the avalanches reported by the observers, avalanche accidents are reported by the rescue services. Furthermore, avalanche maps of various skiing areas and the data from automatic avalanche detection systems are available to the members of the avalanche service.

Snow profiles and stability tests

Layering and snowpack stability have a major impact on the avalanche danger but are difficult to ascertain. To address this, at the start and middle of the month specially trained SLF observers spread across the Swiss Alps. Each produces around 40 flat-field profiles at set measuring sites and also some 40 slope profiles, using for example stability tests ('Rutschblock' tests) on representative test slopes.

The slope profiles and occasionally also selected flat-field profiles are shown on the published snowpack stability map.

Weather forecasts (weather models and edited forecasts)

An avalanche danger forecast is also always based on a weather forecast. Among the products available to the avalanche forecasters to evaluate the short-term weather outlook are:

MeteoSwiss's COSMO 1E and COSMO 2E meteorological forecasting models;

- the European Centre for Medium-Range Weather Forecasts' ECMWF meteorological forecasting model;
- various edited weather and precipitation forecasts from MeteoSwiss;
- additional products from other suppliers if need be.

The members of the avalanche warning service are also in regular contact with the forecasters from MeteoSwiss and SRF Meteo, meaning that difficult situations can also be discussed individually at any time.
Snowpack models

SNOWPACK, the snowpack model devised at the SLF, can be used to calculate the snowpack using meteorological data. As well as other applications, SNOWPACK is used to calculate the snow layering at any IMIS snow station site throughout the winter. These calculations are used in the avalanche warning service's calculations, for instance to determine the depth of fresh-fallen snow or to forecast wet-snow avalanches in case of melting.

Information in border areas

Avalanche danger transcends national borders. To facilitate a better assessment in border regions, information is regularly exchanged with the neighbouring countries' avalanche warning services. The avalanche forecasters also play an active role in the European Avalanche Warning Services (EAWS) association – also see www.avalanches.org.

Capabilities and limitations of the avalanche bulletin

The avalanche bulletin features a forecast of the avalanche danger. However, the very nature of forecasting means that the predictions made may prove to be incorrect. While the SLF makes every effort to ensure the accuracy of the website content and information and the White Risk app, it cannot accept any liability for the correctness and completeness of this content and information.

Avalanche danger means mortal danger! Using the information provided by the SLF does not relieve users of their obligation to assess the avalanche situation for themselves on the ground and to act accordingly – see the disclaimer on the website www.slf.ch.

Scope

The avalanche bulletin only reports on conditions in outlying, unsecured terrain, i.e. away from the zones secured by mountain railways/cableways or safety services and away from secured ski runs and pistes.

Independent assessment

The bulletin only uses general formulations. It cannot assess local conditions and certainly not individual slopes. The correlation that exists between the regional danger level, possible avalanche activity and the relevant consequences (and any action that needs to be taken) must be determined locally by individual users of the bulletin. In this context, snow sports enthusiasts and safety personnel will also need to rely on their own assessment procedures. Such procedures include local weather, snow and avalanche observations; snowpack analyses; examining maps; on-site slope assessment; and individual risk considerations. The safety services may also have access to the results of artificial triggerings of avalanches. All the available information should be taken into consideration before making a decision. Particular attention should be paid to information indicating unstable conditions.

As a rule, the avalanche bulletin provides a more detailed description of the locations where there is a particularly significant danger. Users on site are then responsible for identifying deviations in terms of, for example, altitude or aspect. Messages relating to conditions in the high Alpine regions, the Prealps and regions south of the main Alpine ridge demand special
scrutiny because in most instances, compared to the data on intermediate and high altitudes in other regions, less information is available on these places. Also, very careful consideration is needed when the weather situation is changing rapidly because in the avalanche bulletin it is not always possible to accurately describe the emerging spatial and temporal variations in the avalanche danger.

Reducing the risk with adjustments to behaviour

Avalanches frequently do not occur by chance, and winter sports enthusiasts away from secured ski runs are usually affected by these as a result of their own behaviour rather than providence. Most avalanche accidents are caused by slab avalanches that are triggered by the victims or members of their group. Every avalanche, even a minor snowslide, can be dangerous. Caution is needed not only in view of the danger of being buried but also because of the injuries avalanches can cause and the danger of being swept along and falling. Ultimately, individual behaviour is crucial to the risk. Defensive behaviour, tailored as closely as possible to the specific situation, reduces the risk. Away from secured ski runs and areas, the following points need to be borne in mind in the mountains in winter:

1. Education and experience: Education and training in avalanche danger assessment, e.g. in the form of avalanche courses, offered by a very wide range of organisations for a variety of education levels. Apart from education, experience in assessing the avalanche danger is essential.

2. Information on the current avalanche danger: Besides the most recent avalanche bulletin and the various supporting products offered by the SLF, which will serve as a basis, personal observations and sometimes also local information from for example mountain railway/cableway operators, mountaineering schools and refuge wardens can provide important information on the avalanche danger.

3. Emergency equipment: An avalanche transceiver, a shovel and a probe are considered standard equipment, and an avalanche airbag is recommended. So that this equipment can be deployed in the midst of the stress of an accident, its appropriate use must be practised on a regular basis. Other important items of equipment are a mobile phone, a pocket first-aid kit and, depending on the situation, a helmet.

Danger levels

The SLF uses the five-level European avalanche danger scale to indicate the avalanche danger. The danger level depends on a range of variables, in particular the snowpack stability (or avalanche triggering probability), the prevalence of avalanche prone locations and the avalanche size. A danger level always applies to a region and not to one particular slope. The danger level given in the avalanche bulletin is always a forecast and should be checked on-site.
## Avalanche danger scale

### Short version

<table>
<thead>
<tr>
<th>Danger level</th>
<th>Characteristics</th>
<th>Recommendations for backcountry recreationists</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 very high</td>
<td><strong>Extraordinary avalanche situation</strong>&lt;br&gt;Numerous very large and extremely large natural avalanches can be expected. These can reach roads and settlements in the valley.</td>
<td>You are advised not to engage in winter sports beyond open ski runs and trails.&lt;br&gt;Very rarely forecast.&lt;br&gt;Around 1 % of avalanche fatalities</td>
</tr>
<tr>
<td>4 high</td>
<td><strong>Very critical avalanche situation</strong>&lt;br&gt;Natural and often very large avalanches are likely. Avalanches can easily be triggered on many steep slopes. Remote triggering is typical. Whumpf sounds and shooting cracks occur frequently.</td>
<td>Stay on moderately steep terrain. Heed runout zones of large avalanches. Unexperienced persons should remain on open ski runs and trails.&lt;br&gt;Forecast only on a few days throughout the winter.&lt;br&gt;Around 10 % of avalanche fatalities</td>
</tr>
<tr>
<td>3 considerable</td>
<td><strong>Critical avalanche situation</strong>&lt;br&gt;Whumpf sounds and shooting cracks are typical. Avalanches can easily be triggered, particularly on steep slopes with the aspect and elevation indicated in the avalanche bulletin. Natural avalanches and remote triggering can occur.</td>
<td>The most critical situation for backcountry recreationists. Select best possible route and take action to reduce risks. Avoid very steep slopes with the aspect and elevation indicated in the avalanche bulletin. Unexperienced persons are advised to remain on open ski runs and trails.&lt;br&gt;Forecast for around 30 % of the winter season.&lt;br&gt;Around 50 % of avalanche fatalities</td>
</tr>
<tr>
<td>2 moderate</td>
<td><strong>Mostly favourable avalanche situation</strong>&lt;br&gt;Warning signs can occur in isolated cases. Avalanches can be triggered in particular on very steep slopes with the aspect and elevation indicated in the avalanche bulletin. Relatively large natural avalanches are not to be expected.</td>
<td>Routes should be selected carefully, especially on slopes with the aspect and elevation indicated in the avalanche bulletin. Travel very steep slopes one person at a time. Pay attention to unfavourable snowpack structure (persistent weak layers, old snow problem).&lt;br&gt;Forecast for around 50 % of the winter season.&lt;br&gt;Around 30 % of avalanche fatalities</td>
</tr>
<tr>
<td>1 low</td>
<td><strong>Generally favourable avalanche situation</strong>&lt;br&gt;No warning signs present. Avalanches can only be triggered in isolated cases, in particular on extremely steep slopes.</td>
<td>Travel extremely steep slopes one person at a time and be alert to the danger of falling.&lt;br&gt;Forecast for around 20 % of the winter season.&lt;br&gt;Around 5 % of avalanche fatalities</td>
</tr>
</tbody>
</table>
Full description of the European avalanche danger scale

This scale, introduced by the European Avalanche Warning Services on winter 1993/94, defines the danger level based on the snowpack stability and the avalanche triggering probability. The full description of the scale also includes other columns that have not been internationally agreed relating to typical characteristics, recommendations and consequences.

European Danger Scale with recommendations and additions: see annex.

Danger levels – a simplified picture of reality

The avalanche danger does not increase in linear fashion from one level to another, but disproportionately. That includes the following variables:

- if the snowpack stability, and with it also the additional load required to trigger an avalanche, decreases, and the avalanche triggering probability increases;
- if the prevalence of avalanche prone locations increases, meaning that there are more locations where avalanches are released naturally or can be triggered;
- if the avalanche size increases.

If the additional load required to trigger an avalanche decreases and there are also more locations where avalanches can be triggered, the avalanche triggering probability increases. This is also shown by the stability distribution in the chart below.

In a typical case, all these influencing variables change as indicated above. This means that in the case of 'low' avalanche danger, usually only small avalanches are triggered in just a few locations and mostly only due to a high additional load, while in the case of 'high' avalanche danger, a lot of avalanches, some of them very large, are triggered or are released naturally (without human influence).

However, there are also atypical situations that do not fit into this picture. These are detailed in the next section.

Snowpack stability for danger level 1 (low) to level 3 (considerable). Even at level 2 (moderate) there are locations with poor or very poor stability. As the danger level increases, so does the proportion of locations with poor stability.
Various characteristics of avalanche danger

Also, in the case of less typical avalanche situations the danger level is a measure of the order of magnitude of the avalanche danger. These situations are detailed below along with information about their assessment by the avalanche warning service. As these are atypical situations, no list can ever be exhaustive. In atypical situations deviations from the danger level definition are inevitable. These are set out as far as possible in the avalanche bulletin's danger description.

Faceted-crystal snowpack

In the case of low avalanche danger (level 1) the snowpack is normally well bonded and stable. However, after long periods of fine weather with shallow snow, another form of snow occurring in mid-winter which makes slab avalanches virtually impossible is the whole snowpack being loose and transformed into faceted crystals. The snowpack is then very weak and there are also weak layers, but the bonded layer on top (the 'slab') is lacking. With no bonded layer a fracture cannot be propagated, meaning that there is no possibility of a slab avalanche forming. This means there is a low avalanche danger (level 1), despite or precisely because of the very loose snowpack. 'Stable snowpack' means 'not liable to trigger slab avalanches' and does not refer to the hardness of the layers.

This situation is not a good omen for the immediate future, given that as soon as it is snowed on, the fresh-fallen snow and fresh snowdrift result in the creation of a 'slab' where one did not exist before. Underneath this is the loose old snowpack in the form of a substantial weak layer. The avalanche danger will increase significantly, generally resulting in a long-lasting old-snow problem.

Small, easily triggered snowdrift accumulations

Fresh snowdrift accumulations can often be triggered by individual winter sports enthusiasts. The size of the snowdrift accumulations depends not only on the wind but also on the supply of fresh and old snow which can be transported. For only little snow which can be transported, the snowdrift accumulations are usually so small that getting buried by them is unlikely. In this case, level 2 (moderate) is often used despite the high probability of an avalanche release. In such situations the snowdrift accumulations can usually be seen in good visibility by the trained eye. They need to be avoided especially on terrain where there is a danger of falling.

Old-snow problem with a significant weak layer deep down in the snowpack

The more thickly a weak layer is covered, the more difficult it becomes for a fracture to form there. This is most likely to occur in locations where the snow is relatively shallow or in transitions from shallow to deep snow. In the case of an old-snow problem with a significant weak layer deep down in the snowpack, avalanche prone locations are usually relatively rare. However, avalanches often reach large size, and are therefore particularly dangerous for winter sports enthusiasts. Therefore, the avalanche danger in the case of an old snow problem can sometimes be considerable (level 3) even if the avalanche prone locations are fairly rare. An aggravating factor is that the avalanche prone locations are barely recognisable in old snow situations, even to the trained eye. In the case of weak old snow, more fatalities can be expected than in the case of the other avalanche problems (at the same danger level).
'Skier high'

If numerous large and, in many cases, very large natural avalanches can be expected, the avalanche danger is classified as 'high' (level 4). Under such circumstances, exposed locations (usually sections of transport routes, and in isolated cases also buildings) can be put at risk. In addition to this classic 'road high', there is a further variant of this danger level where very large avalanches are hardly expected (e.g. because there is still too little snow at the start of the winter) but a lot of medium and large avalanches are naturally released and can be triggered very easily at multiple locations. In the case of this 'skier high', winter sports enthusiasts are in severe danger away from secured ski runs. By contrast, transport routes are unaffected or only affected in isolated cases.

Avalanche activity in case of wet and gliding snow

Wet-snow avalanches are seldom triggered by people, and in the case of gliding avalanches this is virtually impossible. Therefore, natural triggering is the main cause of such avalanche types even in the when lower danger levels prevail. The maximum possible naturally triggered avalanche activity, based on the defined danger level, relates mainly to wet-snow and gliding-snow conditions and less to conditions involving dry avalanches. In this context large natural avalanches are possible when there is a moderate danger of wet-snow or gliding avalanches. In the case of a situation with dry-snow avalanches, such naturally triggered avalanche activity normally corresponds to a considerable avalanche danger, as then avalanches are also expected to be triggered by individuals.

Change in the avalanche danger as the day progresses

The avalanche danger changes over time and may not reach or overshoot the boundary between one danger level and another within the period of validity of the avalanche bulletin. Ordinarily the danger increases, for example because snowfall or wind, significantly faster than it recedes again.

If the danger level is likely to change during the day, the level published in the avalanche bulletin and the danger description normally show the situation in the morning. The change (often an increase) is indicated in the danger description. Here are some examples:

- "The avalanche danger will increase and reach level 3 (considerable) in the afternoon." In this case, level 2 (moderate) is marked on the hazard map.
- "Danger level 4 (high) will be reached during the morning." In this case, level 4 (high) is marked on the hazard map.
- "As a consequence of daytime warming and solar radiation, wet-snow avalanches can be expected again from the middle of the day below approximately 2400 m." (With no danger level indicated)

If the avalanche danger is assessed to be level 4 (high) or even level 5 (very high) at night, and then one level lower during the day, the morning rule is deviated from. As when transport routes are endangered, the avalanche danger is also significant at night, the higher avalanche level that applies during the night is given in the evening edition. In the morning edition this is then reduced to the level applying in the morning.
Double map

In typical springtime conditions, the danger of wet-snow avalanches along with daytime warming and solar radiation will increase significantly as the day progresses. During the day the danger of dry-snow avalanches will usually only change slightly in these conditions. Thus, while in the morning dry-snow avalanches are the main danger, in the afternoon the main danger is posed by wet-snow avalanches. In this situation, two maps show both the more favourable morning situation (dry-snow avalanches) and the unfavourable situation in the afternoon (wet-snow avalanches as the day progresses). The transition from one map to another cannot be pinned down to a specific time. It depends on the conditions and the altitude and also in particular the aspect. Whereas on east-facing slopes the danger of wet-snow avalanches will already increase during the morning, this usually occurs only later on west-facing slopes.

In special cases a double map is also used if there is a significant danger of gliding avalanches, and this danger is greater, over a wide area, than the danger of dry slab avalanches. It is worth noting in this case that these two dangers do not vary significantly during the day. Therefore, the two avalanche types are possible throughout the day.

Additional information

Avalanche danger and risk

The avalanche bulletin describes the avalanche danger, i.e. the likelihood of a release and the possible size of avalanches in a specific region, but the exact timing of an avalanche being triggered and the actual length of its starting zone and fracture depth cannot be determined.

An avalanche danger only becomes a risk (i.e. a probability that damage will occur) if endangered individuals, animals, forest, infrastructure etc. are in the area of the potential avalanche. In the avalanche bulletin, the avalanche danger is assessed regardless of the presence of endangered individuals or objects, i.e. on weekends with fine weather and weekdays with poor weather alike, and for populated areas and outlying terrain alike.

If an avalanche is released somewhere on a glacier during a snowstorm, there would obviously be an avalanche danger, but there would be no risk if there were no people in the surrounding area. If the same avalanche is released on a popular touring route on a sunny weekend, the risk would be much greater. The danger given in the avalanche bulletin may be the same in both cases, but the risk will be different.

Avalanches are a very special natural hazard, since unlike flash floods or earthquakes the 'perilous process' of an avalanche can be initiated by human activity. If anyone comes onto a dangerous slope, the artificial additional load can trigger an avalanche. In the case of more than 90% of the snow sports enthusiasts buried by a slab avalanche, they triggered the avalanche themselves or it was triggered by another member of their group.
**Frequency of danger levels**

The most frequently forecasted danger level in the Alps is level 2 (moderate), accounting for almost half of days (per warning region). It thus captures a day with 'average' avalanche danger. Level 3 (considerable) is forecasted on about one third of days. Danger level 4 (high) is only forecasted on 1% of winter days on average, while level 5 (very high) is forecasted even more rarely. In the Jura, the lower danger levels are more frequent.

![Distribution of danger levels (Alps)](image)

*Distribution of danger levels in the avalanche bulletin for the Alps (from 1 December until 30 April) for the winter of 2010/11 until the winter of 2019/20.*

**The avalanche danger will change gradually whereas the scale has levels.**

The danger scale has five levels. However, in reality the avalanche danger changes gradually. This means there is a range within each level.
Typical avalanche problems

The danger description that forms part of the avalanche bulletin cites the predominant avalanche problems as well. The purpose of this is to focus attention on the main aspects. This practice capitalises on the human brain's capacity to recognise and interpret recurring characteristics. Each avalanche problem has a different cause and calls for a specific response tailored to the relevant situation.

If there is no conspicuous avalanche problem (often when a low avalanche danger {level 1} applies), the situation is described with the text "no distinct avalanche problem". This does not imply the absence of an avalanche danger, but indicates only that the danger cannot be unequivocally assigned to one of the categories of typical avalanche problems.

The avalanche bulletin describes only avalanche problems – no more than three together – contributing substantially to the overall danger.

The description contains the following items: A - Danger level ("How great is the avalanche danger?") B - Avalanche problems ("What is the main problem?") C - Avalanche prone locations ("Where is the danger particularly significant?") D - Description ("What are the characteristics of the avalanche situation?")

The avalanche problems cited in the avalanche bulletin, and the criteria applied by the avalanche warning service when they are cited, are described briefly below.

Determining the predominant avalanche problems

The currently predominant avalanche problems are determined using the decision-making tool illustrated below.
1) If in (generally) favorable situations it remains unclear which problem causes the main hazards, "dry-snow avalanches" is used.

2) Relevant layer of new snow or wind slab: The hazard caused by new snow or wind slab has to be equal or higher than the hazard from persistent weak layers.

3) The problem wind slab can prevail for more than 3 days if the wind slabs can still be released and are recognizable as such.

4) If the wind blows in gale-force (average speed > 100 km/h) during the snowfall, use the avalanche problems new snow and wind slab.

5) Criteria, if a weak layer is prone to triggering: The weak layer is at the failure layer of avalanches or identified in snow profiles/stability tests and within the first meter from the snow surface.
6) Weak layer is not at the interface between new snow or wind slab and old snow, so that in case of an avalanche, parts of the old snow release as well. (Otherwise new snow or wind slab is used, and the unfavorable old snow surface is described in the text).

7) If after the snowfall wind slabs were formed that contribute to the overall danger: both, new snow and wind slab are used.

8) Warm glide-snow avalanches (probability of triggering increases during the day) are attributed to the problem wet-snow avalanches as day progresses, because both require the same measures for risk management in the field.
# New snow

<table>
<thead>
<tr>
<th>What?</th>
<th>Characteristics</th>
<th>The avalanche problem is related to current or most recent snowfall. The amount of additional loading by new snow onto the existing snowpack is the crucial factor of the new snow problem. How critical the loading is depends on various factors such as air temperature, wind or characteristics of the old snow surface.</th>
</tr>
</thead>
</table>
| Expected avalanche types | • Dry-snow slab avalanches  
• Dry loose snow avalanches  
• Natural and human triggered avalanches possible |
| Where? | Spatial distribution | In general, a widespread presence and often on all aspects. |
| Position of the weak layer in the snowpack | Usually between new snow and old snow, i.e. close to the interface to the old snow surface, sometimes in the new snow layers and occasionally slightly below in the old snowpack. In the latter case, the problem “persistent weak layers” additionally prevails. |
| Why? | Release characteristics | Dry-snow slab avalanches: Additional load due to snowfall on existing weak layers (old snow surface or below) or newly created weak layers (within the new snow)  
Dry loose snow avalanches: Lack of cohesion between the new snow particles |
| When? | Duration | Typically during snowfall and up to a few days after. |
| How to manage? | Identification of the problem in the field | The new snow problem is fairly easy to recognize since it affects most of the terrain. Consider critical amounts of new snow and recent avalanche activity. |
| Travel advice | Dry-snow slab avalanches: Wait until the snowpack has stabilized and the weak layer has gained strength.  
Dry loose snow avalanches: Danger of being carried by small releases is more important than danger of burial. Consider consequences in steep terrain. |
## Wind slab

<table>
<thead>
<tr>
<th>What?</th>
<th>Characteristics</th>
<th>Wind slabs are formed when loose snow in near-surface layers (new snow or old snow) is transported by wind.</th>
</tr>
</thead>
</table>
|       | Expected avalanche types | • Dry-snow slab avalanches  
• Natural and human triggered avalanches possible |
| Where? | Spatial distribution | Highly variable but typically on leeward slopes in gullies, bowls, near distinct changes in slope angle, behind ridgelines or other wind-sheltered locations. More common above treeline. |
|       | Position of the weak layer in the snowpack | Usually between wind slabs and old snow, i.e. close to the interface to the old snow surface or within the slab layers due to variations in wind speed during storm cycle, but occasionally also slightly below in the old snowpack. In the latter case, the problem “persistent weak layers” additionally prevails. |
| Why? | Release characteristics | The wind slab is an additional load on a weak layer and builds a slab that is particularly prone to support crack propagation. |
| When? | Duration | The wind slab problem can evolve very quickly. The problem lasts typically during the snowdrift event and and tends to stabilize within a few days following the storm cycle. Cold air temperatures can extend the persistence. |
| How to manage? | Identification of the problem in the field | If not buried by new snow, the wind slab problem can be recognized with training and good visibility. Consider wind signs and locate deposits. Typical clues: snowdrift deposits, recent avalanche activity and sometimes shooting cracks or whumpfs. However, it is often hard to determine the age of snowdrift deposits and wind signs do not necessarily imply an avalanche problem (e.g., in absence of a weak layer). |
|       | Travel advice | Avoid snowdrift deposits in steep terrain. |
# Persistent weak layers (old snow)

<table>
<thead>
<tr>
<th>What?</th>
<th>Characteristics</th>
<th>The avalanche problem is related to the presence of one or more persistent weak layers in the old snowpack. These weak layers typically include faceted crystals, depth hoar or surface hoar crystals.</th>
</tr>
</thead>
</table>
|       | Expected avalanche types | • Dry-snow slab avalanches  
• Mostly human triggered avalanches; natural avalanches are rare, mainly in combination with other avalanche problems. |
| Where? | Spatial distribution | The avalanche problem can be widespread or quite isolated. It can exist in all aspects, but is more frequently found on shady, wind sheltered slopes. |
|       | Position of the weak layer in the snowpack | In the old snowpack, often deeply buried. However, when deeply buried triggering is less likely. |
| Why? | Release characteristics | Release of avalanche when loading exceeds the strength of the weak layer. |
| When? | Duration | Weak layers can persist for weeks to months; possibly even during most of the winter season. |
| How to manage? | Identification of the problem in the field | Persistent weak layers are very challenging to recognize. Signs of instability such as whumpfs are typical, but not necessarily present. Stability tests can be helpful to detect the persistent weak layers. Information on snowpack history is critical and reference to the published avalanche report is important. Crack propagation over long distances is common and remote triggering is possible. |
|       | Travel advice | Travel conservatively and avoid large steep slopes. Consider the history of weather and snow cover processes in the area. Be extra cautious in areas with a thin snowpack and at the transition from thin to deep snowpack. This problem is a major cause of recreational avalanche fatalities. |
# Wet snow

In the avalanche bulletin a distinction is made between "wet snow avalanches" and "wet snow avalanches during the day", and these phrases are used to describe the two different avalanche problems.

<table>
<thead>
<tr>
<th>What?</th>
<th>Characteristics</th>
<th>The avalanche problem is related to weakening of the snowpack due to the presence of liquid water. Water infiltrates the snowpack due to melt or rain.</th>
</tr>
</thead>
</table>
|       | Expected avalanche types | • Wet-snow slab avalanches  
• Wet loose snow avalanches  
• Mainly natural avalanches |
| Where? | Spatial distribution | When melting due to solar radiation is the main cause, distribution of the problem is mostly depending on aspect. The elevation is mainly depending on air temperature and humidity. All aspects are affected in the event of rain on snow. |
|       | Position of the weak layer in the snowpack | Anywhere in the snowpack |
| Why? | Release characteristics | Wet-snow slab avalanches:  
• Weakening and failure of pre-existing weak layers in the snowpack or release at layer interfaces where water is ponding.  
• Rain represents also an additional load on weak layers.  

Wet loose snow avalanches:  
• Loss of cohesion between snow crystals |
| When? | Duration | • Hours to days  
• Rapid loss of stability possible  
• Especially critical as water infiltrates for the first time deeper down, once the snowpack has warmed up to 0°C.  
• Natural avalanches might be more likely in the course of the day, depending on aspect (unless rain is the dominating factor). |
| How to manage? | Identification of the problem in the field | The wet snow problem is usually easy to recognize. Onset of rain, snowballing, pin wheeling and small wet slabs or loose wet avalanches are often precursors of natural wet-snow slab avalanche activity. Deep foot-penetration is another sign of increased wetting. |
|       | Travel advice | If the wet snow surface freezes overnight due to clear skies and cold temperatures and develops a strong supporting crust, favourable conditions will usually be present in the morning. After warm, overcast nights, the problem often exists already in the morning. Normally rain on fresh snow creates this problem almost immediately. Good timing and trip planning are important. Consider avalanche runout zones. |
### Gliding snow

<table>
<thead>
<tr>
<th>What?</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The entire snowpack is gliding on the ground, typically on smooth ground such as grassy slopes or smooth rock zones. High activity of glide-snow avalanches are typically related to a thick snowpack with no or only few weak layers. Glide-snow avalanches can occur both with a cold dry snowpack and with a warm moist or wet snowpack. The release of a glide-snow avalanche is difficult to predict, although in many cases glide cracks open prior to release.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected avalanche types</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Glide-snow avalanches; cold dry or 0 °C-isothermal wet snowpack</td>
</tr>
<tr>
<td></td>
<td>• Almost exclusively natural avalanches. Human and artificial triggering is very unlikely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Where?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial distribution</td>
<td>Primarily on smooth ground and on slopes of any aspect, but more often on south-facing slopes.</td>
</tr>
<tr>
<td>Position of the weak layer in the snowpack</td>
<td>Interface between the ground and overlaying snowpack</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Why?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Release characteristics</td>
<td>Glide-snow avalanches are caused by a loss of friction in a moist to wet layer at the snow-ground interface.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Days to months; occasionally during entire winter-season. The release can occur at any time during the day. In spring, glide-snow avalanches occur mostly during the second part of the day.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How to manage?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of the problem in the field</td>
<td>With the presence of glide cracks the problem can often be localized; however, the presence of glide cracks does not indicate imminent avalanche release, which is nearly impossible to predict. Avalanche release without pre-existing glide cracks is also common.</td>
</tr>
<tr>
<td>Travel advice</td>
<td>Avoid areas close to glide cracks.</td>
</tr>
</tbody>
</table>
Avalanche prone locations

Avalanche prone locations can exist in all aspects and altitude zones as a general rule, but in many cases they are not evenly distributed. If they are to be found more frequently in certain aspects and altitude zones than in others, this is stated in the avalanche bulletin. Example: "Avalanche prone locations: in particular on west to north to northeast facing aspects above approximately 2000 m." The indicated danger level applies to slopes that satisfy both criteria – altitude zone and aspect. If this information is not given, the indicated danger level applies to all aspects and altitude zone.

For slopes that do not satisfy both criteria (altitude zone and aspect), it has become customary in backcountry touring to assume the danger level to be one level lower. This rule of thumb has proven reliable in the majority of cases but, like every rule, is subject to exceptions. It can be applied when planning backcountry tours, but does not replace a careful assessment in the open terrain.

If the avalanche prone locations are concentrated in certain types of terrain (e.g. in gullies, adjacent to ridgelines, or in areas with shallow snow cover), this is mentioned in the danger description as far as possible.

Most fatal avalanche accidents occur on slopes whose gradient, aspect and altitude meet the criteria mentioned in the relevant avalanche bulletin. This analysis disregards the danger level prevailing on the day when the accident occurs.

Slope aspect

A north-facing slope falls to the north. If you are standing on a mountain summit looking towards the north (with the sun behind you at midday), the north-facing slope lies immediately below you. In mid-winter, steep north-facing slopes are not exposed to any direct solar radiation. A south-facing slope falls to the south and also receives regular sunshine, even in mid-winter.

In most cases the slope aspects that are particularly affected are indicated in the avalanche bulletin and, if possible, also illustrated in graphical form.

Marginal areas

Conditions change gradually rather than abruptly from one aspect to another. Therefore, the edges of the area coloured in black are not clearly defined boundaries, but show marginal areas that cannot be clearly assigned to either the favourable or the unfavourable area.
Altitude

References to particularly affected altitudes are generally made in increments of 200 m. In the case of dry-snow avalanches, the altitude above which there is an increased number of avalanche prone locations is usually cited. For wet-snow avalanches, the cited altitude is the one below which they are most likely to occur. Formulations referring to a range of altitudes, such as "between 2500 m and 3000 m", are only used occasionally.

Definitions of altitudes

Low altitudes: below approximately 1000 m
Intermediate altitudes: between approximately 1000 m and 2000 m
High altitudes: between approximately 2000 m and 3000 m
High alpine regions: above approximately 3000 m

The tree line is also used as a reference. This denotes the transitional area between forest land, which is sheltered from the wind, and open Alpine terrain, which is exposed to the wind. The tree line is situated at the transition between intermediate and high altitudes. It lies at approximately 2200 m in Central Valais and Engadine, at around 2000 m in the other Regions and at about 1800 m in the Prealps.

Marginal areas

Conditions change gradually rather than abruptly from one altitude zone to another. Therefore, the given altitude is not a clearly defined boundary but shows a marginal area that cannot be clearly assigned to either the favourable or the unfavourable area.

Slope gradient

Most skier-triggered avalanches occur on slopes that are between 35° and 40° at their steepest point.

The slope gradient category given in the avalanche bulletin indicates that there is an increased number of slopes with at least that gradient that are affected. The indicated values (e.g. "steeper than 35°") must, of course, be assumed to be approximate. They are to be regarded as guidelines, and transitional areas must be treated with caution as well. If no gradient is given, it can generally be assumed that steep slopes, i.e. slopes with a gradient of around 30° or more, are meant.
Definitions of slope gradients

<table>
<thead>
<tr>
<th>Extreme, very steep terrain</th>
<th>Particularly unfavourable, for example as regards gradient, terrain profile, proximity to ridge lines or characteristics of the ground. This is mostly used in the avalanche bulletin in connection with danger level 1 (low).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely steep</td>
<td>Steeper than 40°</td>
</tr>
<tr>
<td>Very steep</td>
<td>Steeper than 35°</td>
</tr>
<tr>
<td>Steep</td>
<td>Steeper than 30°</td>
</tr>
<tr>
<td>Moderately steep</td>
<td>Less than 30°</td>
</tr>
</tbody>
</table>

Shady and sunny slopes

Shaded or shady slopes are more prevalent in mid-winter (when the sun is low in the sky) than in spring (when the sun is higher). Depending on the extent of the shadow cast by the near horizon, slopes with any aspect, not only north-facing ones, may be shady. Usually settling and bonding require a long time on such slopes. Conversely, sun-exposed or sunny slopes are more common in spring than in mid-winter. The snow on sunny slopes usually settles and bonds more quickly.

Wind-loaded slopes

Windward slopes face the wind. Snow falling on these slopes is usually blown away. Leeward slopes face downwind (away from the wind). Snow blown off the windward slopes is deposited here, forming a 'snowdrift accumulation'. Leeward slopes often have many times the average snow depth and are therefore sometimes called 'wind-loaded slopes'. Windward and leeward slopes are found not only near mountain summits but also on slopes a considerable distance away from the ridge line. In such situations, the wind can be diverted by the terrain and deviate significantly from the naturally prevailing direction.

Terrain profile

Sometimes, especially in relation to snowdrift, a more detailed description of the particularly affected terrain profiles is provided:

- Gullies and bowls, concavities in the slope
- Areas adjacent to the ridge line, so especially slopes near the ridge and the summit
- Slopes behind abrupt changes in the terrain: These are often also a considerable distance away from the ridge line.
- Bases of rock walls: These are often very deeply covered in snowdrift.

If the principally affected terrain profiles are limited, the avalanche prone locations are usually somewhat spatially limited and relatively easy to locate – at least by experienced individuals when there is good visibility.
As regards the prevalence of avalanche prone locations, the following sequence generally applies:

- (Very) steep slopes: Avalanche prone locations can be expected on all (very) steep slopes of the indicated aspect and altitude. As well as areas adjacent to the ridge line and in gullies and bowls, slopes considerable distances away from the ridge line are affected.
- Wind-loaded slopes: Avalanche prone locations can be expected, in particular, on steep slopes of the indicated aspect and altitude where there is (fresh) snowdrift. This includes gullies and bowls filled with snowdrift.
- Gullies and bowls/areas adjacent to the ridge line: Avalanche prone locations are found in increased numbers in gullies and bowls/adjacent to the ridge line with the indicated aspect and altitude.

**Avalanche types**

**Slab avalanches**

Slab avalanches have a distinct fracture line. They can only occur when a bonded snow layer (the 'slab') lies on top of a weak layer. Initially when the avalanche is triggered, a small fracture, or initial failure, arises in the weak layer, and this is then quickly propagated along the layer. The extent of this propagation depends largely on the characteristics of the weak layer and those of the slab. As a result, the entire slab releases over a large area.

Slab avalanches can occur in dry or wet snow, even long after any snowfall. They can be released naturally (without human assistance), or by any point inside or even outside the slab (remote triggering).

Slab avalanches are the most dangerous avalanche type, accounting for over 90% of avalanche fatalities. They can quickly reach a high speed. If skiers trigger such an avalanche, they often find themselves right in the middle of it and are frequently caught by it.
**Loose-snow avalanches**

Loose-snow avalanches have a distinct trigger point from which they fan out as they plummet downhill and the released snow sweeps more and more snow with it. This type of avalanche often occurs during or shortly after snowfall or when the snow warms up a lot. In the case of dry (powder) snow, this usually requires a 40° gradient at the trigger point. Especially in wet snow, these avalanches can reach considerable sizes in persistently steep terrain.

Loose-snow avalanches are often released naturally. They claim fewer than 10% of avalanche fatalities, with many of these occurring in the summer with mountaineers in the steep terrain being swept away, causing them to fall. Normally, snow sports enthusiasts triggering a loose-snow avalanche are not buried by the snow, as the avalanche sweeps under them.

**Gliding avalanches**

Like slab avalanches, gliding avalanches have a distinct fracture line, but here the whole snowpack slides away. This is only possible on a smooth substrate, typically consisting of grass or slabs of rock. The steeper the slope, the more likely the snow is to slide.

Gliding avalanches can be a major problem for transport routes particularly in snowy winters. For winter sports enthusiasts, they are of less importance as they are not triggered by people but are released naturally. A prerequisite for such gliding snow is that the very base of the snow, at the interface with the ground, is moist, meaning there is little friction. In this context there are two ways in which water enters the lowermost layer:
In mid-winter, the snowpack is generally cold and dry. Then the snowpack becomes moist from below: the warm ground melts the snow lying above it, or the snow sucks water out of the moist ground. In mid-winter, gliding avalanches are possible at any time of the day or night.

At some point in springtime, the whole snowpack warms up to 0 °C. This allows melt water and rain to seep through the entire snowpack and means that its base is moistened from above. In these conditions, gliding avalanches often occur in the typical wet-snow avalanche periods and their frequency increases in the latter part of the day.

Often, but by no means always, the gliding of the snowpack begins slowly, starting with gaps ('glide cracks') forming within it. These can suddenly lead to a gliding avalanche. It is impossible to predict exactly when this will happen, so it is best to avoid staying close to (whether above, adjacent to or below) glide cracks for any longer than absolutely necessary.

**Avalanche sizes**

The European avalanche warning services divide avalanches into five size categories (based on the Canadian classification). The avalanche size is defined, among other things, by the potential damage caused.

Under this definition, fatal 'skier-triggered avalanches' are often classified as 'medium' or (barely) as 'large' avalanches and reaches considerable dimensions, being typically 150 m in length and having a slab size of some 50 m by 80 m and an average slab thickness of around 50 cm. This is equivalent to a slab volume of approximately 2000 m³ or around 400 tonnes.

**Size 1: Small avalanche (sluff)**

**Potential damage**

Unlikely to bury a person, except in unfavourable runout zones

In extreme terrain there is a danger of falling.

**Runout**

Stops on a steep slope

**Typical dimensions**

Length: $< 50$ m

Volume: $100 \text{ m}^3$
Size 2: Medium avalanche

Potential damage
Can bury, injure or kill people
Many avalanches that kill people are classified as 'medium'.

Runout
Can reach the end of the relevant slope

Typical dimensions
Length: 50 – 200 m
Volume: 1000 m³

Size 3: Large avalanche

Potential damage
Can bury and destroy cars, damage trucks, destroy small buildings and break a few trees
Many avalanches that kill people are classified as 'large'.

Runout
Can cross flat terrain (well below 30°) over a distance of less than 50 m

Typical dimensions
Length: Several hundred metres
Volume: 10,000 m³

Size 4: Very large avalanche

Potential damage
Can bury and destroy trucks and trains. Can destroy fairly large buildings and small areas of forest. Very large avalanches can occur at danger level 3 and are typical of danger levels 4 and 5.

Runout
Traverses flat terrain (well below 30°) over a distance of more than 50 m. Can reach the valley floor.
Typical dimensions
Length: 1 – 2 km
Volume: 100,000 m$^3$

Size 5: Extremely large avalanche

Potential damage
Can devastate the landscape and has catastrophic destructive potential. Typical for danger level 5.

Runout
Reaches the valley floor
Largest known avalanche

Typical dimensions
Length: > 2 km
Volume: > 100,000 m$^3$

Additional load
Avalanches can be triggered naturally (without human influence) or by an artificially applied additional load.

Naturally triggered avalanches
When an avalanche bulletin warns of naturally triggered avalanches, these could be slab, loose-snow or gliding avalanches. The main triggers for these are, for example, the load caused by snowfall or rain, decreasing firmness of the snowpack because of warming or moistening, and a change in the slab. When an avalanche bulletin does not explicitly warn of naturally triggered avalanches, this does not mean they can be completely ruled out.

Additional load
Information given about additional load in the avalanche bulletin refers to dry slab avalanches.

- An artificial additional load is applied not only, for example, by winter sports enthusiasts and snowmobiles/groomers but also by avalanche blasting (i.e. explosions to provide protection from avalanches).
- Natural additional loads are fresh-fallen snow and rain and also collapsed cornices and ice debris. These can subject the snowpack to a very high load, thereby triggering avalanches even in fairly favourable conditions.
The definitions used by the European avalanche danger scale distinguish between 'low' and 'high' additional loads. From danger level 3 ('considerable') upwards, avalanches can even be triggered by a low additional load, whereas up to level 2 ('moderate') in general a high additional load is required.

**Low additional load**
- Individual skiers or snowboarders making gentle turns, not falling
- Individual snowshoe hikers
- Several of the above winter sports enthusiasts with spacing between them

**High additional load**
- A fall or a jump
- Two or more winter sports enthusiasts standing close together
- Snowmobile/groomer
- Avalanche blasting
- Collapse of a cornice, ice debris

Information on the additional load is helpful, but these are only rough guidelines which should not be accorded undue significance in the assessment. As a rule, the probability of an avalanche being triggered increases with rises in the additional load. This means that with a higher additional load there are more trigger points than with a lower one. The following aspects also need to be considered:

**Size of the load**
The load on the snowpack will differ depending on the individual and how he or she is moving about on the snow and on the conditions: often it will be greater on the descent than on the ascent and violent short turns or jumps will exert a greater load than big turns.

**Punctual or large area**
A slab avalanche can be triggered when a weak layer breaks over a sufficiently large area (initial failure). The punctual load of a pedestrian may lead to a fracture lower down in the snowpack but over a smaller area, meaning that sometimes this will not be propagated. This is particularly true when the person concerned treads deeply into the snow. Therefore, depending on the snowpack, the load of a pedestrian may be more or less dangerous than the more extensive load of a snowshoe hiker or a skier.

**Spacing distances**
Spacing distances avoid the loads of various individuals overlapping. As the depth increases, an additional load is spread over an ever larger area, so that the additional load per unit area is reduced. The area of influence is the largest in the case of a low-lying weak layer or a hard slab but as a rule is still less than one square metre. As a result, the areas of influence of individual backcountry ski tourists ascending one after another do not usually overlap, and so having spaces between them only slightly reduces the load on the slope. However, as these spaces are mainly about helping to reduce the risk of multiple individuals getting buried in the snow, they are nevertheless a sensible precaution to take.
Other influences on the danger level

The danger level does not depend solely on the load required to trigger an avalanche but also on the prevalence of avalanche prone locations and the avalanche size. Where, for example, only a few avalanche prone locations or only small avalanches are to be expected, sometimes the danger level may still be 2 ('moderate') if only a small additional load is needed to trigger an avalanche (also see 'Small, easily triggered snowdrift accumulations' in the section 'Danger levels').

Division into regions

For the purposes of the avalanche bulletin, the Swiss Alps are divided in alignment with the warning regions used by the other federal natural hazard agencies (MeteoSwiss, Federal Office for the Environment (FOEN), Swiss Seismological Service (SED)). Groups consisting of several warning regions are formed, generally by applying climatological or political criteria, yielding overarching region names (see the maps below).

Great care is required when interpreting references in the context of backcountry tours in regional border areas. For example, the Jungfrau region is usually accessed from the north (northern flank of the Alps or Bernese Oberland), but the backcountry touring area mostly lies in Valais.

Marginal areas

There are no clearly defined boundaries between two regions with different danger assessments (e.g. different danger levels or different distributions of avalanche prone locations) but instead transitional areas which in many cases cannot be clearly assigned to either avalanche situation. This means that in a marginal area several kilometres wide, it can be assumed that either the more or the less favourite situation may apply.

Those undertaking backcountry ski or snowshoe hiking tours in such areas should therefore consult the avalanche bulletin for both regions in question.
Warning regions (the 149 smallest units)
Northern and southern flanks of the Alps, and the Jura
Main Alpine Ridge, Northern Alpine Ridge and Inneralpine Regions

The Main Alpine Ridge extends from Val Ferret via the Great St Bernard, Monte Rosa, Simplon, Gotthard, Lukmanier, San Bernardino, Maloja and Bernina passes to beyond Val Müstair.

The Northern Alpine Ridge covers a belt running from the Dent du Midi via the Wildstrubel and Jungfrau regions and Gotthard, Tödi and Vorab to Liechtenstein.

The Inneralpine Regions encompass the regions between the Main Alpine Ridge and the Northern Alpine Ridge, namely those of Central Valais, and parts of Northern and Central Grisons and Engadine.
Major political regions

The **Grisons southern valleys** consist of Val Mesolcina and Val Calanca (collectively Moesano), Val Bregaglia, Val Poschiavo and Val Müstair.
Political subregions 1
Political subregions 2

The **Gotthard region** consists of Obergoms, the Grimsel region, Urseren, Tavetsch, the Upper Valle Leventina and Val Bedretto.
### European danger scale with recommendations and additions

<table>
<thead>
<tr>
<th>Danger level</th>
<th>Title</th>
<th>Snowpack stability</th>
<th>Avalanche: size, incidence, probability of release</th>
<th>Additional characteristics</th>
<th>Recommendations for back-country recreationists</th>
<th>Implications and recommendations for transportation routes and settlements</th>
<th>Forecasting frequency and percentage of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 very high</td>
<td>Extraordinary avalanche situation</td>
<td>The snowpack is poorly bonded and largely unstable in general.</td>
<td>Numerous very large and often extremely large natural avalanches can be expected.</td>
<td>Heavy snowfall</td>
<td>You are advised not to engage in winter sports beyond open ski runs and trails. Respect closures.</td>
<td>Avalanches can travel large distances, including beyond the extent of familiar paths. Transportation routes and settlements can be seriously endangered. Extensive safety measures are usually required.</td>
<td>Very rarely forecast. Around 1% of avalanche fatalities.</td>
</tr>
<tr>
<td>4 high</td>
<td>Very critical avalanche situation</td>
<td>The snowpack is poorly bonded on most steep slopes.</td>
<td>Triggering is likely even from low additional loads on many steep slopes. In some cases, numerous large and often very large natural avalanches can be expected.</td>
<td>Remote triggering is typical. Whump sounds and shooting cracks occur often. Critical amount of new snow exceeded or heightened likelihood of wet-snow avalanches.</td>
<td>Stay on moderately steep terrain. Heed runout zones of very large avalanches. Unexperienced persons should remain on open ski runs and trails.</td>
<td>Avalanches can travel large distances, in particular within familiar paths. Exposed objects (mostly sections of transportation routes, but in isolated cases also buildings) can be endangered. Consider taking safety measures.</td>
<td>Forecast only on a few days throughout the winter. Around 10% of avalanche fatalities.</td>
</tr>
<tr>
<td>3 considerable</td>
<td>Critical avalanche situation</td>
<td>The snowpack is moderately to poorly bonded on many steep slopes.</td>
<td>Triggering is possible even from low additional loads particularly on the indicated steep slopes. In certain situations some large, and in isolated cases very large natural avalanches are possible.</td>
<td>Whumpf sounds and glide cracks typically occur, but not in all cases. Remote triggering can occur. In many cases the critical amount of new snow is reached, fresh snowdrift accumulations exist over a wide area, or the snowpack is either prone to triggering due to persistent weak layers or is being weakened by water infiltration.</td>
<td>The most critical situation for backcountry recreationists. Select best possible route and take action to reduce risks. Avoid very steep slopes with the aspect and elevation indicated in the avalanche bulletin. Unexperienced persons are advised to remain on open ski runs and trails.</td>
<td>In individual cases exposed objects (mostly sections of transportation routes) can be endangered. Here, consideration should be given to taking safety measures.</td>
<td>Forecast for around 30% of the winter season. Around 50% of avalanche fatalities.</td>
</tr>
<tr>
<td>2 moderate</td>
<td>Mostly favourable avalanche situation</td>
<td>The snowpack is only moderately well bonded on some steep slopes; otherwise well bonded in general.</td>
<td>Triggering is possible primarily from high additional loads, particularly on the indicated steep slopes. Very large natural avalanches are unlikely.</td>
<td>Warning signs can occur in isolated cases. Weak layers in the snowpack are prone to triggering in some places. Fresh snowdrift accumulations are mostly shallow or cover only small areas.</td>
<td>Routes should be selected carefully, especially on slopes with the aspect and elevation indicated in the avalanche bulletin. Travel very steep slopes one person at a time. Pay attention to unfavourable snowpack structure (persistent weak layers, old snow problem).</td>
<td>Very little danger.</td>
<td>Forecast for around 50% of the winter season. Around 30% of avalanche fatalities.</td>
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<tr>
<td>1 low</td>
<td>Generally favourable avalanche situation</td>
<td>The snowpack is generally well bonded (or entirely loosely packed) and stable.</td>
<td>Triggering is generally possible only from high additional loads in isolated areas of very steep, extreme terrain. Only small and medium natural avalanches are possible.</td>
<td>No warning signs present. Small fresh snowdrift accumulations can exist in isolated cases.</td>
<td>Travel extremely steep slopes one person at a time and be alert to the danger of falling.</td>
<td>No danger.</td>
<td>Forecast for around 20% of the winter season. Around 5% of avalanche fatalities.</td>
</tr>
</tbody>
</table>
Additional information and definitions

- The avalanche bulletin usually describes areas where the danger is most significant in greater detail (e.g. elevation zone, aspect, topography, etc.).
- Slope angles:
  - very steep, extreme terrain is especially unfavourable as regards the slope angle, topography, proximity to ridgelines or ground conditions
  - extremely steep: steeper than 40°
  - very steep: steeper than 35°
  - steep: steeper than 30°
  - moderately steep: less than 30°
- Additional load (artificial triggering):
  - high (e.g. group of skiers without spacing, snowmobile/groomer, avalanche blasting)
  - low (e.g. single skier, snowboarder or snowshoe hiker)
- Natural: without human influence
- Aspect: the compass direction which a downward slope faces
- Ski runs: marked pistes and descents
- Trails: marked snowshoe and winter hiking trails
- Experience: experience in assessing avalanche danger means the ability to obtain and correctly interpret external sources of information, e.g. the avalanche bulletin, and one’s own observations with regard to avalanche danger, and to respond correctly in accordance with the situation.
- For warning signs (recent avalanches, whumpf sounds, shooting cracks), see https://www.whiterisk.ch/en/explore#u=05-02-05-01
- For critical amount of new snow, see https://www.whiterisk.ch/en/explore#u=01-05
- Exposed: especially exposed to danger, e.g. section of road in steep terrain within range of even medium avalanches